Materials & Methods

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ASTM Annual Meeting Preview

European Research on Behavior of Metals

Beryllium-Copper for Large Machine Parts

Heat Treating of Connecting Rods

Ultrasonic Inspection of Brazed Joints

Needle Tubing for Mechanical Applications

High Temperature Self-Locking Fasteners

New Potting Compound with Controlled Shrinkage

Mica Paper for Electrical Insulation

Workability of Stainless Steels

Price-Volume Ratios for Plastics and Metals

ELECTROPLATED COATINGS ON THE LIGHT METALS
—Materials & Methods Manual No. 33

JUNE
1952

THE MAGAZINE OF
MATERIALS ENGINEERING
DEVOTED TO THE MATERIALS PROBLEMS OF PRODUCT DESIGN AND MANUFACTURE

Phister Fire Extinguishers, featuring "all copper and brass construction," are made in a variety of portable sizes and are readily recharged after use. Copper and copper-alloy components provide high resistance to corrosion. Other Anaconda Alloys are used for valve parts, packing nuts, couplings, bushings, gage guards, hose clips, pump parts, etc.

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In the home or plant, the cry of "fire" is always frightening, and infinitely more so if the extinguisher fails to work.

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2. It must be ready to go into operation instantly . . . even after years of disuse.
3. Air pressure and liquid level gages must indicate condition at a glance.
4. Most important, dependable, corrosion-resistant metals must be used to eliminate the most common cause of failures.

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INLAND

The Materials Outlook

The steel industry is working on a plan for complete decontrol of steel distribution with minimum dislocation. The plan will be submitted to the Office of Defense Mobilization. . . . First, the ticket system would be progressively abandoned, freeing customers to use available steel as they wished. Then, control of the quantities of each steel item which can be produced would be abandoned. The priority of direct military and atomic energy requirements would be safeguarded. . . . This differs sharply from the NPA's recent relaxation of control. The steel industry wants to completely abandon the present control mechanism, not just loosen it.

Producers are assuring the zinc-consuming industries that there will be sufficient zinc available in 1952 to meet all foreseeable requirements. . . . The Defense Production Administration now classifies High Grade and Special High Grade zinc as a material which should be used as an alternate for scarce materials whenever possible. The Special High Grade zinc is used in making die casting alloys.

The long range steel price-supply situation is looking brighter. . . . The cost of working taconite ores will not be as high as was feared, according to one mining machinery manufacturer. The taconite ores, at first at least, will be more accessible than the hematites that have been worked away from the surface. The cost of making iron from taconite may be about the same or even a little less than the cost of processing hematites.

One problem of the metallurgist in the present confused situation: some steels, especially those bought abroad, may not meet the specifications under which they were offered. . . . A recent batch from France was offered as medium-carbon steel, carbon content 0.45%. When it arrived, it was 0.70% carbon. Rather than refuse it, the purchaser changed his heat treating procedure.

Direct current electromagnetic pump with no moving parts, capable of pumping large quantities of liquid metals at a rapid rate of flow, has been developed at the Argonne National Laboratory. Copper bars are soldered to opposite sides of metal tubing, assembly is placed between poles of an electromagnet, and inlet and outlet pipes are attached to tubing. Electric current passing through the liquid develops in it a longitudinal thrust.

Low pressure laminates with a remarkable degree of heat stability have been developed by Dow Corning Corp. Molded of glass cloth and silicone bonding resin at pressures from 3 to 30 psi, they will withstand continuous

(Continued on page 4)

The Materials Outlook *(continued)*

exposure to temperatures in the range of 500 F and intermittent exposure to as high as 900 F. . . . Physical and electrical properties of these materials are comparable to those of conventional high-pressure silicone-glass laminates molded at 1000 psi or higher. Their mechanical strength is far superior to silicone-bonded moldings of chopped glass, mica, asbestos or other inorganic fillers. . . . Flat sections can be laminated in thicknesses ranging from 0.01 to 2.00 in. Test laminates are already under evaluation for possible use as radomes, air ducts, tubing, instrument protectors and guided missile noses. Their combination of properties also recommends them as covers for de-icing elements on wing and stabilizer tips and on the leading and trailing edges of helicopter blades.

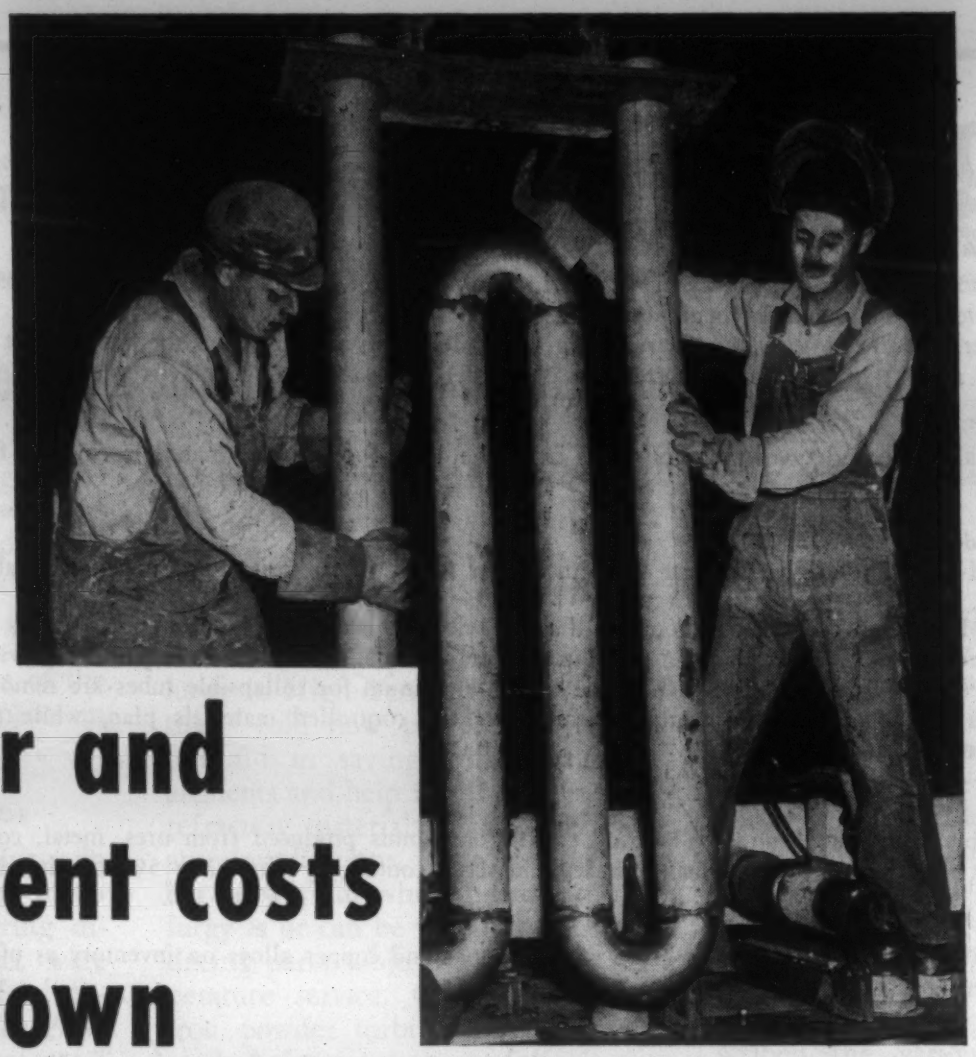
Shell molding was one of the feature items at the Foundry show. . . . The method, also called the "C" process, eliminates the need for much sand and sand-handling equipment and offers greater casting accuracy. It was first reported to the industry in 1947. Actual demonstrations were begun about two years ago. . . . A year ago, only three important foundries were found to be interested in shell molding. Today, the process is used in making many automotive parts that formerly were fabricated, forged or cast by conventional methods. It is also used for railroad castings, radiation and boiler sections, aviation castings, plumbing fittings, pressure pipe, kitchen equipment, water pumps, electrical fittings, diesel castings, marine castings, hand tools, home utility items, electric motor housings, and cutter heads.

A new English apparatus enables founders to melt cast iron borings in cupolas. The borings are charged into the cupola just above the melting zone by a pneumatic ram. No flux or binder is required. The coke, limestone, solid metal and other charge materials above prevent the ejection of the borings by the upward flow of gases. No other alterations are made in the cupola. Under normal conditions, the melting losses of the borings are less than 3%. In two British cupolas, a saving of 33-1/3% has been made in the consumption of pig iron, bought scrap and heavy steel.

Automobile note: several manufacturers are experimenting with aluminum door construction. The Nash Rambler was the pioneer in this field. In 1950, Nash brought out a door frame utilizing extruded aluminum. The apparent widths of corner parts and center pillars was reduced, corrosion resistance and lightness were secured, and an attractive appearance was presented.

A hydraulic press specially designed by Lake Erie Engineering Corp. for hot extrusion of steel is being installed at the Watervliet, N. Y., plant of Allegheny Ludlum Steel Corp. They will use this equipment for production of alloy steel solids and hollows, including tubes. This application will be one of the first in America. Glass is used as both a lubricant and an insulator. The press has a working force of 1800 tons. Billets up to 7½ in. in dia and 24 in. long are handled.

See page 6 for "Materials Control Orders"



One of five W-shaped Inconel tube units used to heat sodium nitrate salt baths for the heat treatment of aluminum alloys at temperatures from 870° F. to 980° F.

Power and replacement costs go down

. . . when Inconel Radiant Tube assemblies go in

Chance Vought had a heat-treating problem.

In order to give aluminum alloy parts extra hardness it was necessary to immerse them in a sodium nitrate salt bath heated between 870°F. and 980°F.

That's where the problem came in.

They were heating the solution with electrical elements which corroded rapidly and required frequent replacements.

Finally they decided to replace this type of unit with radiant heating.

In each of their 15-foot Low-Carbon-Nickel-Clad steel tanks, they installed five W-shaped immersion tube assemblies fabricated from Inconel®. The seamless Inconel tubing used on the job was 4½" O.D. by .083" wall thickness and the return bends were of 4½" O.D. by .125" Inconel. The sections were joined by welding. Each tube is fired under induced draft by an atmospheric natural gas burner at the rate of 250,000 BTU per hour.

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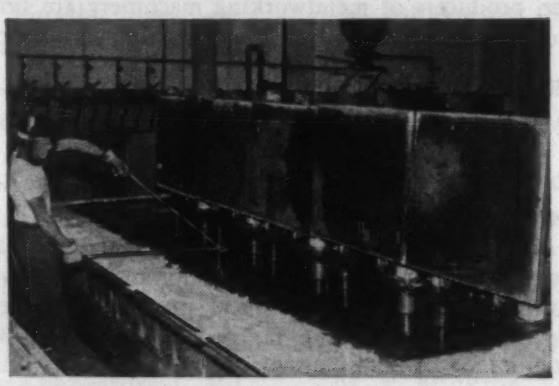

One of two 15' salt bath tanks, at Chance Vought Aircraft, Dallas, Texas, constructed of Low-Carbon-Nickel-Clad Steel.

If your heat-treating applications are ones where Inconel is no longer permitted by government regulation, ask about Incoloy® — a new, heat-resisting, nickel-saving companion alloy to Inconel.

Right now, both Inconel and Incoloy are on extended delivery because of essential defense needs. Orders should be placed well in advance of anticipated work schedule . . . and should include NPA rating and complete end-use information.

And remember, if you have a heat-treating problem, Inco's High-Temperature Engineers will be glad to help you. Write today for your copy of the High-Temperature Work Sheet which has been specially designed to aid you in setting down your problem.

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Materials Control Orders

A summary highlighting actions of the NPA affecting engineering materials during the period from Apr. 11, 1952 through May 10, 1952.

● **CONTROLLED MATERIALS PLAN**

Reg. 1, Dir 1—An amendment effective July 1, 1952 will permit certain manufacturers to obtain substantially increased quantities of carbon steel, alloy steels and aluminum beginning with the third quarter of 1952.

Reg. 1, Dir 3—Under this amendment, persons receiving CMP allotments directly from the government who are unable to place orders during the first two months of any given quarter can place the entire allotment for delivery during the last month.

Anticipated Changes:

Reg. 1—The removal of second quality carbon steel from the list of controlled materials for the fourth quarter of 1952 will be announced shortly.

● **ALUMINUM (Orders M-5, M-26, M-27)**

An amendment to M-5 raises the level of order acceptance from 100% of authorized production schedules, excluding backlog, to 125%, including backlog.

An amendment to M-26 removes all restrictions on the sale, delivery and use of aluminum closures and closure liners. Inventories will continue to be regulated by NPA Reg. 1. The quantity of aluminum used for the applications will be controlled by CMP allocations to the manufacturers. Regulations restricting the use of aluminum for collapsible tubes are removed by an amendment to M-27. Aluminum continues to be allocated to manufacturers under the controlled materials plan, while inventories of collapsible tubes continue to be limited by NPA Reg. 1.

● **COBALT (Order M-80)**

An amendment to this order places under allocation cobalt compounds produced from ores, metal, concentrates and refinery residues in addition to cobalt fines, cobalt oxide, cobalt powder and scrap containing more than 5% cobalt which were covered previously.

● **COPPER (Order M-74)**

Under an amendment to M-74, permission is given to use copper and copper alloys on inventory as of July 1951 for the manufacture of certain building materials.

Anticipated Changes:

If copper strikes continue for another month, sharp curtailment of copper allocations to brass mills, wire mills and foundries will be necessary. Only direct military needs can be met if the strikes continue.

● **FINISHES (Order M-104)**

Under this new order, producers of metalworking machinery are limited to one coat of primer or sealer, no filler excepting spot filling of bad cracks or fissures, no more than two coats of paint, lacquer or enamel.

● **IRON AND STEEL (Orders M-6A, M-75, M-80)**

An amendment to M-6A limits the amount of nickel-bearing stainless steel that may be sold to customers without authorized CMP orders.

Order M-75, which restricted the sale, delivery, use and inventories of steel shipping drums, is revoked. However, the drums will remain subject to the 60-day inventory limitations of NPA Reg. 1.

An amendment to M-80 permits users of low carbon (0.03 max) austenitic stainless steels or austenitic steels stabilized with columbium, tantalum or titanium to employ columbium-content welding rods for welding such steel. These welding rods may be employed also in power generating and chemical process industries for welding nonferrous nickel-base alloys or columbium-bearing steels which operate continuously in the range 800 to 1600 F where other stabilized compositions are not suitable. With these exceptions, no columbium or columbium-tantalum bearing steel shall be used where a substitute will meet service requirements.

Anticipated Changes:

Inventory limitations on structural steel will be expanded from 45 to 120 or 145 days if request is made by the individual involved. An amendment will permit allotments which cannot be obtained in a given quarter to apply to orders for the succeeding quarter. Because of the improved tungsten supply, removal of restrictions on the melting and distribution of high-speed tool steels is being considered.

● **RUBBER (Order M-2)**

Removal of controls on acquisition, inventories and consumption of both natural and artificial rubber opens the way to free competition between these materials. However, it is provided that consumption of GR-S and butyl rubbers cannot be permitted to fall below 450,000 and 60,000 long tons, respectively.

● **TIN (Order M-8)**

An amendment requires users of pig tin, secondary tin, solder, babbitt or other alloys or materials containing 1.5% tin (excepting ores and concentrates) to certify that these materials will be used only for purposes specified in the order unless special authorization is obtained.

Anticipated Changes:

An order removing control from most secondary tin mill products will be issued shortly.

● **ZINC (Order M-9)**

Anticipated Changes:

Revocation of order M-9 under which the allocation and use of zinc is controlled is under consideration.

● **NPA REGULATIONS**

Reg. 7—This regulation was issued to make available to the public interpretations of NPA regulations and orders. Publication of an interpretation will be made only when considered in the general public interest.

Powder Metallurgy in Defense Featured at Metal Powder Show

A highly successful meeting of the powder metallurgy industry was held in Chicago, Apr. 28-29. About 600 persons registered for the eighth annual meeting of the Metal Powder Association, which included both technical sessions and exhibits of the latest advances and developments in the field.

Ordnance Corps Activities

The role of powder metallurgy in defense was the theme of the meeting, and several papers bearing directly on this timely subject were presented. J. D. Dale, Frankford Arsenal, in his paper "Aspects of Powder Metallurgy in National Defense," reviewed developments to date on the use of metal powders in ammunition components.

The established policy of the Ordnance Corps has been to get the sintered iron rotating bands into limited production as soon as safety and common sense permits. Additional firing tests will be conducted shortly which, if successful, will make it possible for continuing larger scale use of iron powder rotating bands. Development programs are now underway on the design of the rotating band and band seat, the type of impregnating material, the surface preservation treatment, the addition of small percentages of copper, and different methods for assembly of the bands to the shell.

Another important project is the use of metal powder components for mechanical time fuzes and VT fuzes. Many of the parts lend themselves to production by powder metallurgy, and the large scale production of the M21A4 booster rotor is an example of this.

Other possible applications of the powder metallurgy method are the the production of cartridge cases and practice projectiles. Cartridge cases, .50 caliber in size, have been drawn from a billet of specially processed sintered iron on an experimental bases. Also 20-mm practice projectiles made of iron powder are in the early stages of development.

High Temperature Applications

Another present and potential defense use of metal powders is in jet engines, guided missiles and rockets. J. J. Harwood, Office of Naval Research, in his paper "Powder Metallurgy in High Temperature Application," told how powder metallurgy can aid in saving critical alloying elements and help fulfill the need for refractory materials in high temperature applications. There are a number of ways in which powder metallurgy is or can be put to use in producing parts subject to elevated temperature service. Copper infiltrated iron powder turbine blades are already being used successfully in jet engine construction. The titanium carbides and molybdenum-base alloys have considerable advantages for high temperature use. Finally, use of porous metal powder parts to permit "sweat" cooling offers some interesting and promising possibilities.

Electronic Cores

A third paper directly concerned with the role of powder metallurgy in defense was "Magnetic Powder Cores for Military Communciation Equipment," by E. Both, Signal Corps Engineering Laboratories. By reviewing the results of some recent tests of iron powders for cores, it was indicated that techniques of core manufacture are probably a much more important factor in influencing the core properties than the iron powder itself.

Closely related to the previous paper was the symposium on electronic core materials of which W. E. Cairnes, Radio Cores, Inc., was chairman. Three papers were presented: "Carbonyl Iron Powder," by George O. Altman, General Aniline & Film Corp.; "Hydrogen Reduced Iron Powder," by R. H. Rodrian, C. K. Williams & Co.; and "Electrolytic Iron Powder," by W. M. Shafer, Plastic Metals Div., National Radiator Co. Each of these papers reviewed the properties and characteristics of one particular group of iron powders, and outlined their scope of use as electronic core materials.

Hot Pressing

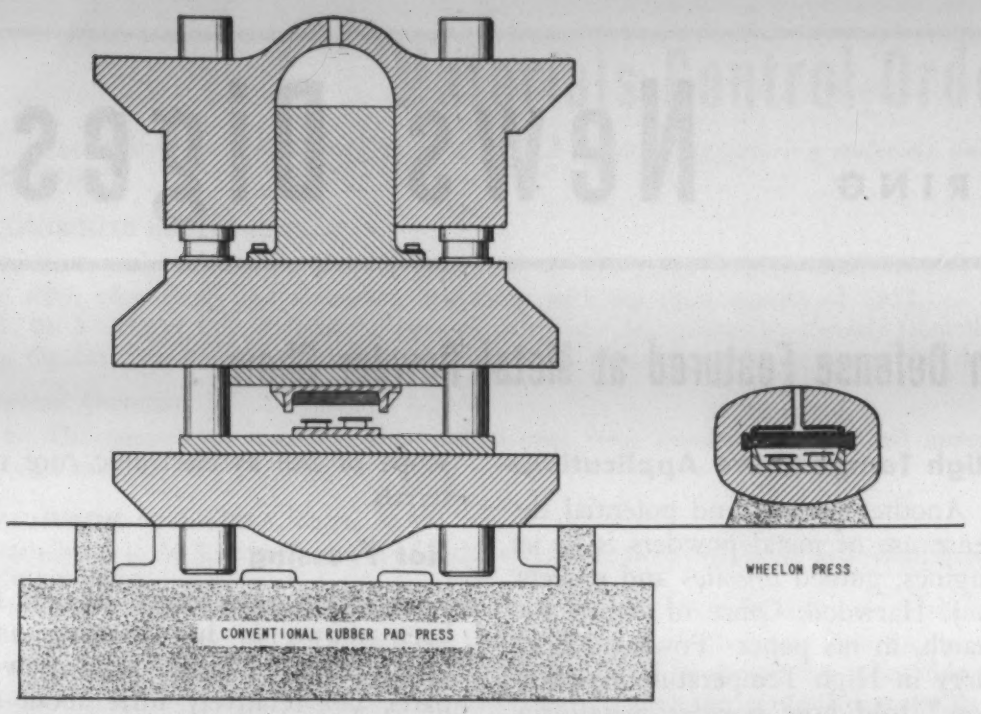
In recent years much interest has been shown in hot pressing as a means of producing metal powder parts, but relatively little about the actual techniques has been made public. Therefore, the paper by J. F. Kuzmick of Welded Carbide Tool Co., entitled "Recent Practical Applications of Hot Pressing," was well received because of its detailed description of hot pressing methods being commercially employed. Besides processing details, the paper described the various products now being made by hot pressing.

Other Papers

An interesting paper on "Powder Metallurgy in the Manufacture of Clocks and Mechanisms" was presented by F. Lux of the Lux Clock Manufacturing Co. He showed how the adoption of powder metallurgy techniques for many small clock parts resulted in (1) lower costs (about 50%); (2) simple, cheaper assembly; (3) reduced inspection; and (4) improved quality.

M. F. Judkins, Firth Sterling Steel and Carbide Corp., presented a paper on "Carbides-Machining and Ordnance Applications." Because of restrictions placed on release of information on carbide cores used in armor piercing projectiles, most of his paper was devoted to a description of "Method X" developed for machining extremely hard materials. This method uses electric energy directly to remove the material and virtually no heat is involved. It can be used for intricate shaping or drilling to tolerances of 0.0005 in.

W. D. Jones, Powder Metallurgy Ltd. (London) reviewed "Progress in Powder Metallurgy in Europe." This interesting paper set forth the author's observations acquired recently during a tour of powder metallurgy plants in Sweden, Holland, Germany, France, Italy, Spain, Portugal and South Africa.



The new Wheelon Press, like the conventional press, forms the sheet metal over a metal form. In the Wheelon Press, the hydraulic pressure is applied to an inflatable bag instead of through a moving press head.

Small Press Forms Airplane Parts

The Douglas Aircraft Co. recently announced a new type of hydraulic press for forming airplane sheet metal parts. Developed by O. A. Wheelon of Douglas, the new tool is known as the Wheelon Direct Hydraulic Press. The new presses are much smaller than conventional presses of comparable capacity. Heavier gage metals can be formed, with less hand finishing work. Douglas expects the Wheelon press to replace the Guerin Process machines in aircraft production to a large extent.

The Guerin Process forms sheets between a rubber pad and a form block. The metal is placed on the form block. The rubber pad, held in the press head, is pushed down on top of the form block. This forms the sheet to the block contour. The tooling is easy and inexpensive, and there is no setup time since the form block does not have to be located accurately with respect to a mating die. There are also disadvantages. Most parts are incompletely formed, and a great deal of hand work is required to complete them.

From top to bottom: the metal blank, pre-cut from 0.25-in. 75S aluminum; the Kirksite form block; top view of finished part; bottom view of part. Thicker sheets can be formed wih less hand work by the new process.

The shortcomings of the Guerin Process have become more apparent in the last five years. Heavier metal gages are being used. To make sufficiently large parts of 0.125-, 0.188- or 0.250-in. sheet, presses of tremendous sizes would be required.

The new Douglas process looks like the answer, according to Douglas. As in the older method, the sheet is formed around a metal block by the pressure of a rubber pad. There is no moving press head, however. The pad is forced down by hydraulic pressure inflating a bag above it. The working pad is softer and has more elongation than conventional press pads. The pressures on the sides of the block are as high as those on the top face. A harder pad is used between the metal and the working pad to protect the soft working pad from the metal edges. The new press is simple to operate and can be tailored in design to meet requirements. Low headroom is no problem, as it is with conventional presses.

Transistors Lighten Army's Communication Equipment

An important step in development of small, light military communications equipment has been accomplished with use of transistors instead of vacuum tubes, the Department of the Army has announced. The transistor is a germanium crystal which will amplify alternating current, including radio waves. It has been used in an experimental device, which is a miniature converter used with radio-teletypewriter equipment to change radio impulses to the kind of electrical current required to actuate a teleprinter. It requires only about a one-hundredth part of the current needed for equipment now in use.

Transistors, developed by Bell Telephone Laboratories in 1948, perform many of the functions of vacuum tubes but do not require power for heating filaments. Consequently, they use much less current. Estimated life of the type of transistor used in the new converter, if employed 24 hr a day, is about seven years. Vacuum life is much shorter. The transistors are solids, permitting the new converter to withstand greater vibration and shock.

Lead Supply-Demand Picture Reviewed at Association Meeting

The changed lead supply-demand picture was subjected to a thorough airing at the 24th Annual Meeting of the Lead Industries Association held in Chicago recently. The outlook for this metal was discussed by those best informed among the domestic and foreign lead producers and the major lead consumers. General Chairman of the sessions on lead production was Felix E. Wormser, vice president, St. Joseph Lead Co.

In commenting on communication cable, T. G. Stover of the Western Electric Co. stated that "The unprecedented demand for telephone cable to satisfy expanding defense and civilian telephone service requirements has imposed a tremendous problem of overcoming shortages in lead and copper. New developments and substitutions have provided considerable relief. To supplement lead jacketed cable, two new types of telephone cable have been introduced: namely, Alpeth and Stalpeth, both of which utilize polytheylene plastic sheathing. With regard to the copper shortage, the Western Electric Co. recently has been experimenting with aluminum conductors and field tests are now in progress. It is hoped that all cable raw materials best suited to cable manufacture ultimately may be selected and used in accordance with their relative suitability and cost. Consequently, the knowledge gained from these developments and substitutions should provide the communications industry with more flexibility, leading to greater operating and economic advantages."

Mr. J. J. Sharkey, of Olin Industries, spoke on the use of lead in ammunition. "On a percentage basis the use of lead in the small arms ammunition industry is relatively small, but it may be of some interest to note the average annual consumption of 33,100 tons in the pre-war years 1935 to 1938, inclusive, represented approximately 5.52% of total consumption, while the annual average use of 34,837 tons in the post-war years 1946 to 1951, inclusive, represents only about 3.16% of the total consumption. These percentage figures, of course, indicate an increase in consumption by other industries during the post-war years. The Defense Program will probably not require as much lead for small arms ammunition in 1952 as was used during World War II years because of the changes in types of such ammunition.

A vice president of the Magnus Metal Co. described the use of lead bearings in railroad cars. "The railway journal bearing industry constitutes one of the largest volume markets for lead. The lead content of journal bearings purchased or manufactured by American railroads in 1951 exceeded 27,000 tons. While strong efforts are being made by the roller bearing interests to supplant the lead-base solid type bearings on freight cars, operational and economical advantages of the latter actually make for its superior adaptability to rail freight service as practiced in this country."

A pessimistic view of the possibilities for lead in the type metal field was taken by Lewis S. Somers, executive vice president of Imperial Type Metal Co. Mr. Somers noted that "Due to a large number of technological developments in the graphic arts industry, the use of type metal is rapidly becoming obsolete. Photographic composition will soon replace slug and type casting equipment and rapid, wholly mechanical etching of zinc, aluminum and magnesium will replace the use of stereotype. In this field as well as that of electrotyping, plastics are rapidly taking the place of lead-base alloys."

The use of lead in chemical construction was covered by J. D. Magee, general manager of the Lone Star Construction Co. "It is essential that those selling lead for use as a material of chemical construction reach all potential users of such equipment with information regarding the proper use of lead and its corrosion resistant qualities; information concerning where it should and should not be used," declared Mr. Magee. "For the best interests of our industry we should advise our customers against using lead when it will not give satisfactory service without, however, neglecting the many other installations where lead is very superior to other materials of construction. Lead construction prices are still in line with more competitive

(Continued on page 13)

JETAL BLACK

the JETAL process

THE **BEST** FOR **FERROUS METALS!**

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Preview of

50th Anniversary Meeting

American Society for Testing Materials

The 50th Anniversary Meeting of the American Society for Testing Materials will be held in New York City June 23-27. It promises to be an outstanding event with its technical program on materials and its apparatus and photographic exhibits.

Technical Program

Hundreds of the Society committees will meet beginning Sunday, June 22. Technical sessions will be held throughout the week, beginning Monday, at the Hotel Statler. The program will feature 30 symposiums and sessions on a variety of subjects. Those of particular interest to materials engineers are listed below.

The Edgar Marburg Lecture this year will be on "Non-Destructive Testing" by Dr. R. C. McMaster, Battelle Memorial Institute, and the first H. W. Gillett Memorial Lecture will be on "Man, Metals and Power" by N. L. Mochel, Westinghouse Electric Corp. The Gillett Lecture is at 4 P. M., Monday, and the Marburg Lecture at 4 P.M., Wednesday, both at the Hotel Statler.

At the Annual Dinner, Wednesday, which this year includes special features in keeping with the Society's 50th Anniversary, the chief speaker will be Dr. D. W. Bronk, President of the National Academy of Sciences. The President's Luncheon, Tuesday, will include the annual address of ASTM President T. S. Fuller, General Electric Co., and short addresses from Dr. R. E. Zimmerman, United States Steel Co., and Monsier A. Caquot, leading French scientist and President of the International Organization for Standardization.

Exhibits

Many new and interesting pieces of materials testing equipment will be exhibited at the Hotel Statler June 23-27. Leading manufacturers and distributors of testing apparatus and supplies will emphasize the continued progress being made in providing engineers with proper facilities for evaluating the properties of engineering materials. A list of the exhibitors is given on the following page.

Adjoining the apparatus exhibit will be the photographic exhibit, the theme of which will be "Materials Testing and Research". As in previous exhibits, there will be sections on photomicrography, particularly metallography, and on radiography. Also included will be electron micrographs.

Technical Program Highlights

Monday, June 23

Strength and Ductility of Metals at Elevated Temperatures (Morning and Afternoon)

Subjects include: effect of notch geometry, recovery and creep in an alloy steel, embrittlement and notch sensitivity of heat resisting steels, effect of sigma in 25-20 chromium-nickel steel, behavior of stainless steels.

Tin (Morning and Afternoon)

Subjects include: tin conservation in making cans, tin coatings, tin resources and production, solders in automobile industry.

H. W. Gillett Memorial Lecture (4 P. M.)

Man, Metals and Power, by N. L. Mochel

(Continued on page 17)

CUT COSTS WITH THE

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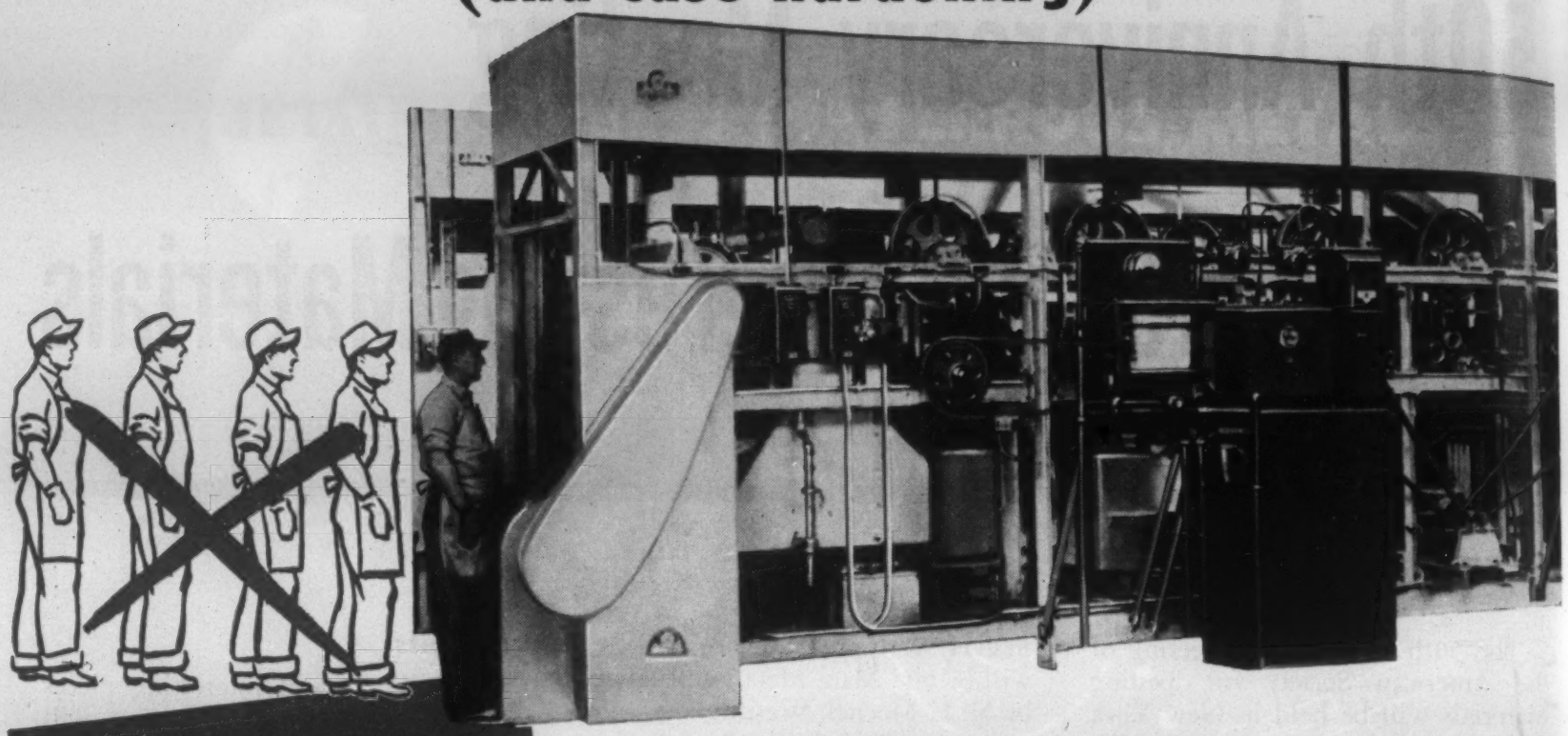
(and case hardening)



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Closer control of depth and other properties of the case.

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Preview of ASTM Meeting (continued)

Tuesday, June 24

Fatigue (Morning and Afternoon)

Subjects include: a new interpretation of the understressing effect, fatigue of 76S-T61 aluminum alloy under combined bending and torsion, fatigue machines for low temperatures and for minature specimens, new resonance vibration exciter and controller for dynamic testing, plastic-flow and work hardening phenomena in fixed-deflection fatigue tests of magnesium alloys.

Conditioning and Weathering (Morning)

Subjects include: organic coatings, adhesives and organic plastics, metallic coatings, accelerated weathering devices, small scale conditioning.

Electron Microscopy (Afternoon)

Subjects include: study of development of fatigue failures, quantitative metallography, microstructure of bainite in steel.

Paint (Afternoon)

Subjects include: paints, varnishes, lacquers, accelerated tests for protective coatings, resins, painting of metals.

Wednesday, June 25

Light Microscopy (Morning and Afternoon)

Subjects include: methods of microscopy, application to plastics and resins, examination of metallic specimens, apparatus for microscopy.

Determination of Elastic Constants (Morning)

Subjects include: dynamic methods, evaluation of several static and dynamic methods, methods for nonmetallic materials, influence of temperature on elastic moduli, and Poisson's ratio of various commercial steels.

Fretting Corrosion (Morning and Afternoon)

Subjects include: present status of problem of fretting wear, and effect of lubricants.

Edgar Marburg Lecture (4 P. M.)

Non-Destructive Testing, by R. C. McMaster.

Thursday, June 26

Non-Destructive Testing (Morning and Afternoon)

Subjects include: comparison radiographs of welds, papers by foreign speakers on developments in Europe.

Testing Adhesives for Durability and Permanence (Morning)

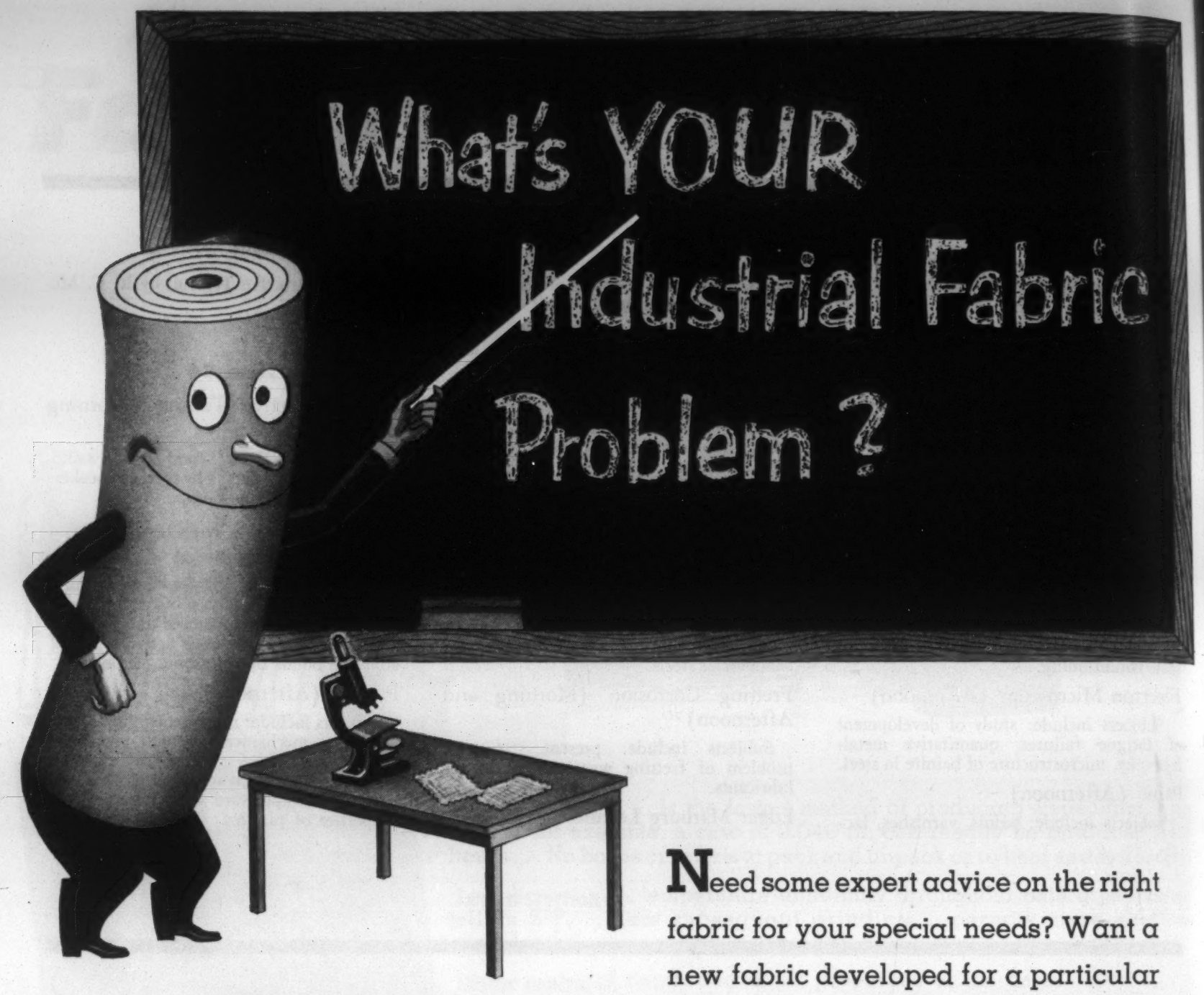
Subjects include: glass adhesives, durability of wood adhesives, effects of specimen structure in permanence tests of wood adhesives, measurement of deterioration of adhesive bonds by ultrasonic method.

Plastics (Afternoon)

Subjects include: measurement and significance of mechanical strength properties of plastics, effect of molding conditions on permanence of plastics, measurement of effect of temperature on some physical properties of plastics.

List of Exhibitors

Aetna Scientific Co.
American Cystoscope Makers, Inc.
American Instrument Co.
American Optical Co.
Anderson Machine Co.
Applied Research Laboratories
Atlas Electric Devices Co.
Baird Associates, Inc.
Baldwin-Lima-Hamilton Corp.
Beckman Instruments, Inc.
C. A. Brinkmann & Co.
Brush Development Co.
Buehler Ltd.
Burrell Corp.
Carlson Co.
Central Scientific Co.
Consolidated Engineering Corp.
Corning Glass Works
Curry & Paxton, Inc.
Custom Scientific Instruments, Inc.
J. W. Dice Co.
Doble Engineering Co.
Eastman Kodak Co.
Eldorado Mining and Refining Ltd.
Fisher Scientific Co.
General Electric Co.
General Radio Co.
General Scientific Equipment Co.
William J. Hacker & Co.
Hanovia Chemical and Mfg. Co.
Instron Engineering Corp.
Jarrell-Ash Co.
Leeds & Northrup Co.
Lindberg Engineering Co.
Magnaflux Corp.
Micro Metallic Corp.
Milton Roy Co.
H. R. Moore Co.
National Forge & Ordnance Co.
National Spectrographic Labs.
North American Philips Co.
Tinius Olsen Testing Machine Co.
Parr Instrument Co.
B. F. Perkins & Son, Inc.
Picker X-Ray Corp.
Radium Chemical Co., Inc.
H. Reeve Angel & Co., Inc.
Riehl Testing Machines Div., American Machine & Metals, Inc.
Scott Testers, Inc.
Sperry Products, Inc.
Steel City Testing Machines, Inc.
Superior Electric Co.
Tagliabue Instruments Div., Weston Electrical Instrument Corp.
Testing Machines, Inc.
Arthur H. Thomas Co.
Thwing-Albert Instrument Co.
Uddeholm Co. of America
United States Testing Co.
Wallace & Tiernan Products Inc.
Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc.



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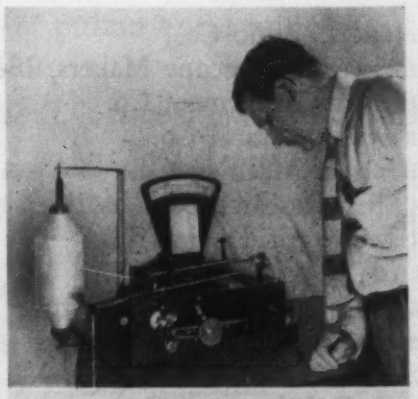

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European Research on the Behavior of Metals Yields Promising Results

by THOMAS J. DOLAN, University of Illinois

Unusual testing methods to determine design criteria and to study the nature of fatigue and creep are leading to a better understanding of materials.

● DURING THE COURSE of a recent tour of four European countries sponsored by the Office of Naval Research, the writer visited 22 research and development laboratories. Although interested primarily in fatigue testing and stress analysis, the opportunity was taken to review progress in other areas of the testing field. The work observed and reported here should, in at least some instances, suggest possible methods of attack for the American engineer.

Fatigue Investigations

Fundamental studies of the nature of fatigue that should contribute to the clarification of the phenomena which lead to structural damage are in progress in a number of European laboratories. Developmental studies with special techniques also promise to yield data valuable in establishing design criteria for specific applications of members subjected to repeated loading. Some of these investigations and several interesting new procedures are discussed briefly in the following paragraphs.

In England, rotating-beam and axial-load fatigue tests are in progress at elevated temperatures. By determining an equivalent "dynamic stress-strain curve", it was possible to show that the fatigue strengths (corrected for curvature of the stress-strain relation) were identical in the two types of test. No differences caused by "size effect" were found in the fatigue strengths of rotating beam specimens from 0.16 to 0.3 in. in dia at elevated temperatures, while an increase in frequency from 10 to 2000 cycles per min for carbon steel produced about a five-to-one increase in the number of cycles to fracture.

Studies related to spalling fatigue failures in metals are in progress in Scotland on a standard four-ball lubrication evaluation machine in which heavy loads are applied to a fixed ball which is forced against a nest of three rotating balls. At high loads, structural changes have been noted in the balls at points below the surface of the contact area. Definite evidence of subsurface cracking on a microscopic scale has been obtained. Observation of surface crack development at various stresses indicate that the cracks start at the inner edge of the contact area between the balls where microscopic slipping occurs.

Axial-load fatigue tests and torsional fatigue tests are in use in Sweden to obtain fatigue strengths of forged and decarburized surfaces as compared with the same metals having standard polished surfaces. The results indicate that decarburizing of the surface is extremely damaging, especially for metals heat treated to relatively high hardness levels. The tests will be continued to determine the statistical dispersion and the nominal shape of the S-N curves.

Several specially designed machines have been developed in Sweden for determining the strength of ball bearings. Some tests are run as long as 10,000 million cycles to determine the statistical spread in life before failure by spalling of the balls or races occurs. These data are used to select nominal load ratings for the bearings, based on a probability of 10% failures for the rated life.

Repeated bending and torsion tests in England on crankshafts of several grades of cast iron have indicated that high strength irons are more notch-sensitive than the lower strength materials. Finished components, which always contain stress raisers, show little better fatigue properties when made of high-strength irons than when made of

low strength irons of sound quality.

Fatigue studies in Sweden of typical aircraft materials such as 24S-T and 75S-T aluminum alloys have permitted the preparation of complete Goodman diagrams for these two metals, with and without stress-raisers in the form of holes. The mean stresses in these tests were varied from tensile values to high compressive stresses under axial-loading conditions. A recently completed investigation to determine the optimum relationship between fatigue strength and cost of construction for a pinned connection showed that the joint with the closest possible fit was strongest in fatigue but also was the most expensive to prepare.

An extensive program has been planned in Sweden to obtain the statistical dispersion of fatigue life of several commonly-used metals at a number of stress levels. Six laboratories will cooperate in the testing of from 800 to 1000 specimens of each of six different metals. When the program is completed, attempts will be made to formulate design data from which predictions can be made of the percentage of failures to be expected within a given number of cycles at any predetermined stress level.

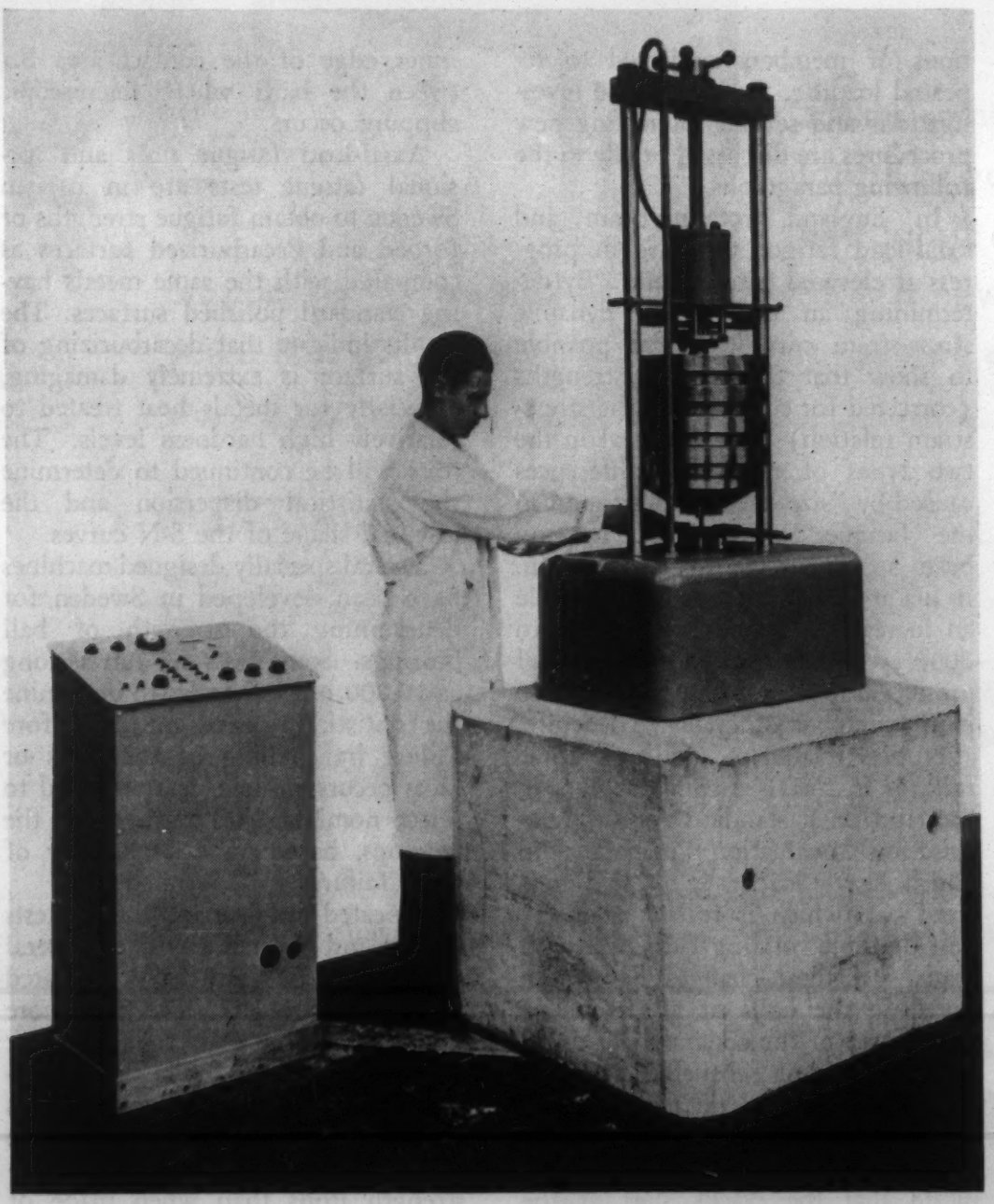
As a result of failures found in steam turbine disks after several years operation, a large turbine manufacturer in Sweden is conducting extensive corrosion-fatigue and stress-corrosion investigations at 212 F. Examination of the failures has led to the conclusion that the cracks were due primarily to stress-corrosion cracking in the region of the turbine at which the dew-point is reached. It is suspected that the use of sodium silicate for treating boiler water is one of the major causes of the failures; small quantities of hydrogen sulfide generated at the high temperature of the boiler act as a serious accelerator of stress-corrosion cracking.

A Swiss laboratory has had two Amsler Vibrophore fatigue testing machines operating almost continuously for three years with excellent results. These are constant amplitude of force machines with frequencies of 100 to 300 vibrations per sec. The relative motion required to produce high stress levels for standard metal specimens are well within the range of operation; this machine, though very noisy, is reported to be one of the most versatile axial-load machines now available for fatigue testing.

A new English machine has been developed for the determination of the flexural fatigue strength of gear teeth. In this machine, a spur gear is held with one tooth against a fixed support and the load is applied to a second tooth in a manner which subjects the two teeth to a pair of equal, opposite, and co-linear forces. Cyclic loads from zero to a maximum are applied hydraulically at the rate of 2000 cycles per min. A simple, direct means of determining the bending fatigue strength of individual gear teeth is thus obtained.

Under development in England is a resonance-type fatigue machine, to apply large axial loads, in which the exciting forces are furnished by a "slipping clutch" in the form of a slider plate. Thus, a reciprocating motion is transferred from the slider plate to the main inertia mass by friction. With the slider plate moving at constant amplitude, the frictional forces excite the mass until the motion agrees with that of the slider plate; hence, the extremely precise speed control normally required for a resonance system is not necessary. As an accessory, a new type of eccentric has been designed for varying the amplitude while the machine is running.

Amsler high frequency Vibrophore fatigue testing machine. The Vibrophore is reported to be one of the most versatile axial-load machines now available for fatigue testing. (Adolph I. Buehler)



Creep Investigations

Extensive research on the creep of metals at high temperatures is in progress in England and Switzerland, and considerable information is being accumulated. Although most of the procedures are similar to those used in this country, one of the Swiss creep testing laboratories has, in addition to the usual single specimen machines, a unique furnace in which 36 specimens are tested simultaneously. The specimens are loaded individually by air pressure through separate reducing valves and the

Battery of rotating beam fatigue testing machines. Similar machines are in wide use in Europe to study the properties of materials.

loads are measured by standard pressure gages. To maintain uniform temperature, the outer wall of the furnace is rotated continually about the vertical axis of the machine. In this laboratory a general study of creep and stress-rupture is in progress, considerable data having been obtained on cadmium-tin alloys at room temperature for periods up to 40,000 hr. It has been found that the data on both notched and unnotched specimens repeat many of the characteristics observed in the creep of steels at elevated temperatures. Certain discontinuous jumps in the creep rates and the rupture-stress data have been observed in both the tin alloys and in steels. These discontinuities occur only after long periods of testing, as long as 20,000 hr for the cadmium-tin alloys.

Other Testing Developments

Some idea of European thinking in other testing fields can be obtained from the following paragraphs, which outline other developments in studies of materials.

Extensive tests on ship plate have been made in England to evaluate laboratory methods of measuring brittleness. On the basis of notched tensile tests, it has been concluded that the use of rectangular specimens in which the width is at least three times the thickness eliminates most of the size effects in determining the transition temperature. Completely brittle or completely ductile fractures are obtained more readily with such specimens and thus a more accurate prediction of the transition temperature can be made from the appearance of the fracture or from the lateral contraction.

A key-hole notched standard Swiss Charpy specimen is in wide use in Switzerland, not only to determine transition temperatures of steels, but also as an index of quality, especially for heat treated materials. A low Charpy value is taken as an indication of an abnormal condition requiring more investigation before use.

In Scotland, mechanical strength tests are in progress to study the applicability for beams and columns in building and ship construction of channels formed from thin sheet and to determine optimum proportions for adequate load carrying capacity and resistance to local buckling.

A Swiss group is determining Young's modulus of small metal specimens at room and elevated temperatures by a vibration method. Longitudinal vibrations developed by light blows on one end of a small cylindrical specimen are detected by magneto-strictive pick-up and the frequency of the resulting electrical signal is measured by matching with a signal from a standard oscillator.

Experimental Stress Analysis

With the exception of some of the electronic equipment developed in Sweden and the wire strain gage mentioned below, most of the experimental methods of stress analysis with static and dynamic strain measurement, use of brittle lacquers, etc. do not appear to be as highly developed in Europe as they are in America. However, an outstanding development for use in strain measurement is the wire-resistance strain gage (resembling an SR-4 in size and electrical characteristics) which orig-

Krouse high-speed fatigue testing machines are used for testing wire specimens. (Jones & Laughlin)

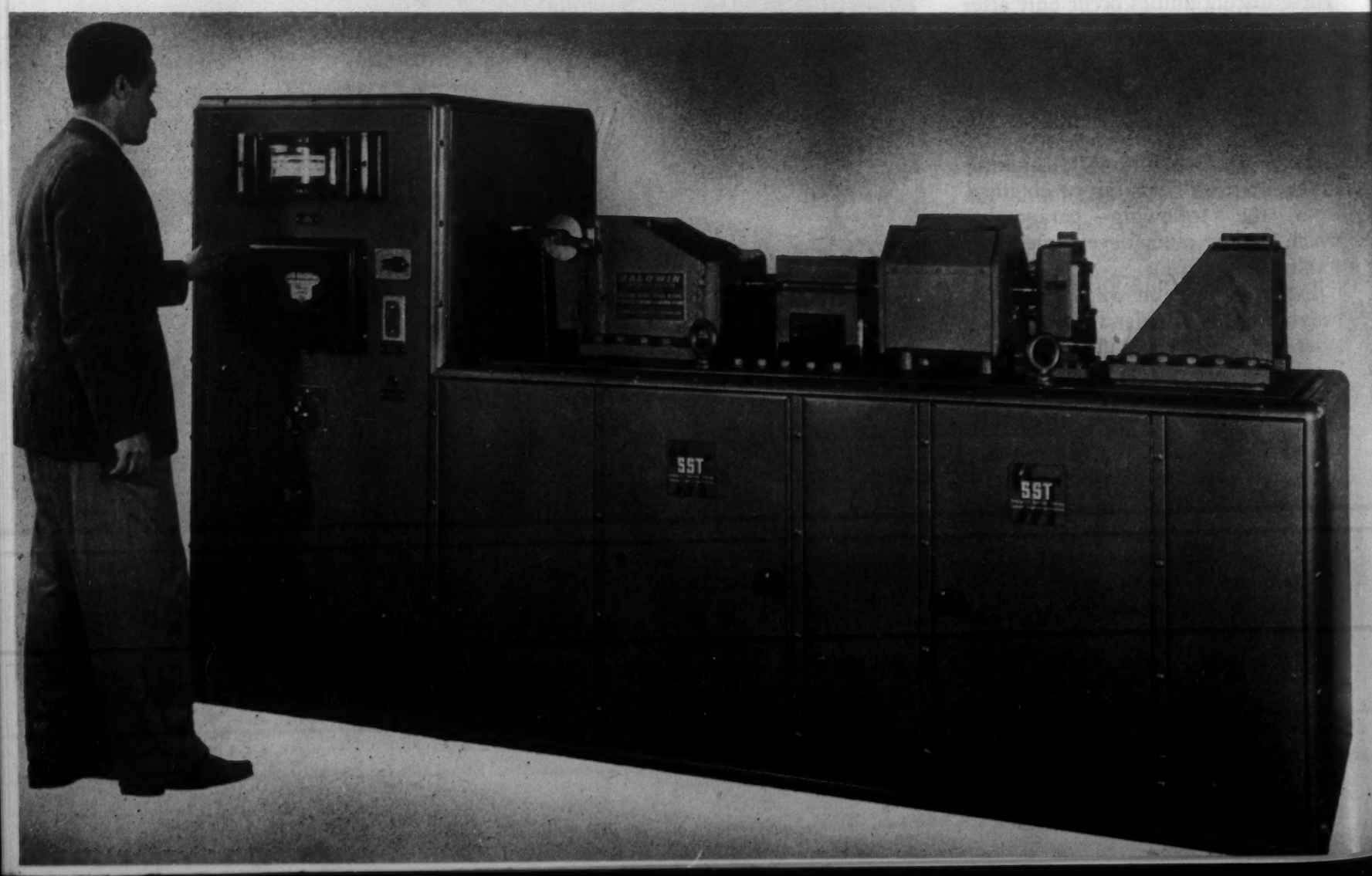
inated in Sweden and is now being manufactured in Switzerland. This gage uses parallel filaments of fine resistance wire bonded in a thin transparent plastic base. The transverse connections are made by soldering fine copper wires across the resistance filaments at the ends of the gage length; therefore, these gages are not sensitive to strain at right angles to the gage axis. The transparent binding medium permits visual inspection of the gage after mounting to determine whether air bubbles have been trapped in the cement.

There are fewer sources in Europe from which specialized electrical and mechanical research instruments can be obtained, and those available are relatively expensive. Hence, the variety and quantity of instrumentation and equipment found in the European establishments is usually somewhat more limited than in comparable American laboratories. However, this discourages random "testing" and the research scientists spend more time and thought in preliminary planning and theoretical studies. As a result, their experimental work often proves more fruitful than some of the "tests" conducted in America.

Adapted from a report presented to the Office of Naval Research on Project NRO31-005.

Metallurgist taking a strain reading on a creep testing machine. Extensive studies on the nature of creep are in progress in European laboratories. (U. S. Steel.)

Baldwin turbine blade fatigue machine for service up to 1800 F permits fatigue testing under combined flexural and tensile stresses. Wheelco controls maintain uniform temperature distribution over the test section.



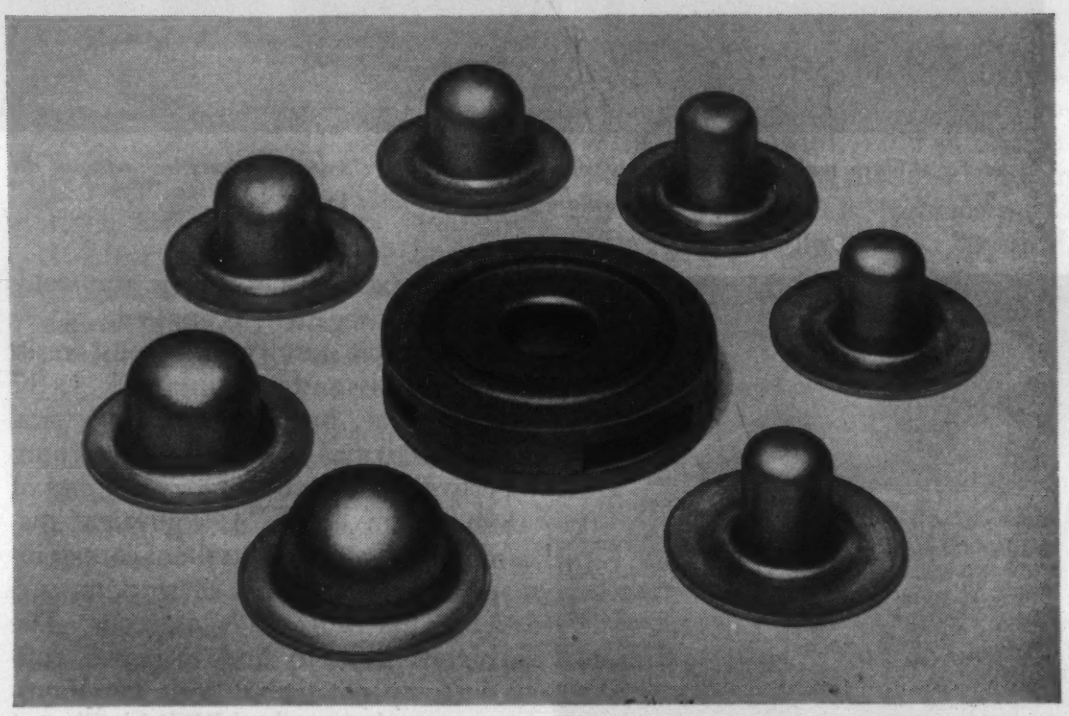
Beryllium-Copper Useful for Large Machine Parts

by **JOHN T. RICHARDS,** Development Engineer, The Beryllium Corp.

High corrosion resistance, wear resistance, electrical conductivity and impact strength are some of the properties that led to the choice of beryllium-copper for the five typical applications described here.

● ALTHOUGH MUCH HAS been written regarding the use of beryllium-copper strip and rod in small elastic and structural components, little data are available regarding larger parts employed in machine tools and other heavy equipment. For bellows, diaphragms and contacts, spring and endurance properties are essential. In larger members, wear and impact strength are frequently required, and, depending upon the nature of the application, corrosion resistant and current-carrying qualities may also be needed.

To illustrate the versatility of beryllium-copper in heavy industry, five typical applications have been selected. They are: a deep drawing die, flash welder insert, automatic screw machine parts, grinder spring clamp, and seam welder bushing. In each case, a different combination of beryllium-copper's useful properties dictated the choice of the material.



A typical cast beryllium-copper drawing die surrounded by a series of successive stainless steel cups drawn from a flat blank without intermediate annealing.

Dies for Deep Drawing Stainless

In attempting to deep draw some of the more refractory grades of stainless steel, United Tool & Die Co. experienced considerable difficulty due to pick-up on the cup radius. Originally, dies were made from air hardening tool steel having a hardness of 60-62 Rockwell C. Even when dies were carefully polished and special lubricants employed, the pick-up resulting from drawing made it necessary to polish each cup.

In an effort to reduce production time and cost, beryllium-copper was selected and found to offer the best answer for either short or production runs because of its resistance to wear and galling. By eliminating polishing and intermediate annealing operations production was speeded and lubricating problems were simplified. The possibility of splitting the die through heating up was also reduced.

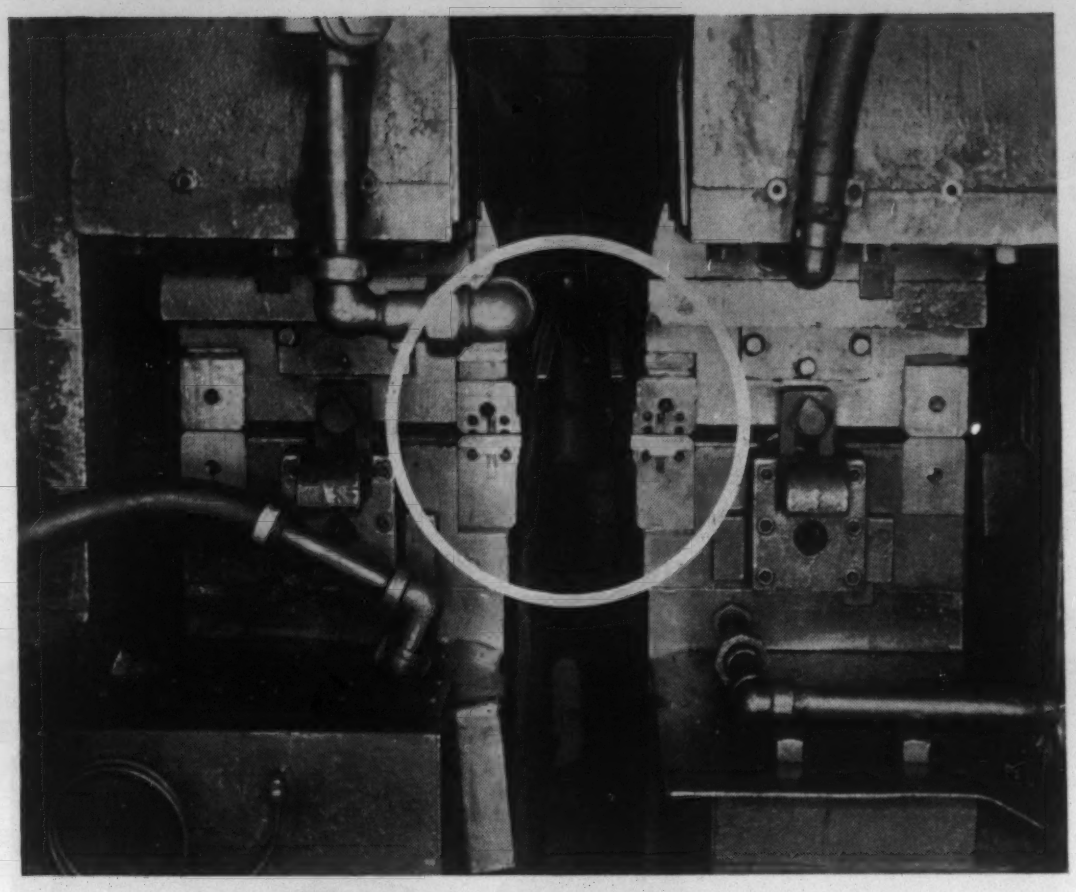
For this application, cast beryllium-copper blanks are specified in the solution-annealed condition. They are machined prior to heat treating to an average hardness of 42-45 Rockwell C. Dies are then lightly polished with crocus cloth in the drawing direction before being placed in service.

The accompanying figure shows a typical beryllium-copper drawing die surrounded by a series of cups produced from stainless sheet stock without intermediate annealing. For a given die, it has been found possible to handle sheet thicknesses ranging from 0.032 to 0.093 in. by merely changing the steel punch. In the case of large dies, it is sometimes more economical to employ a beryllium-copper insert in a steel die.

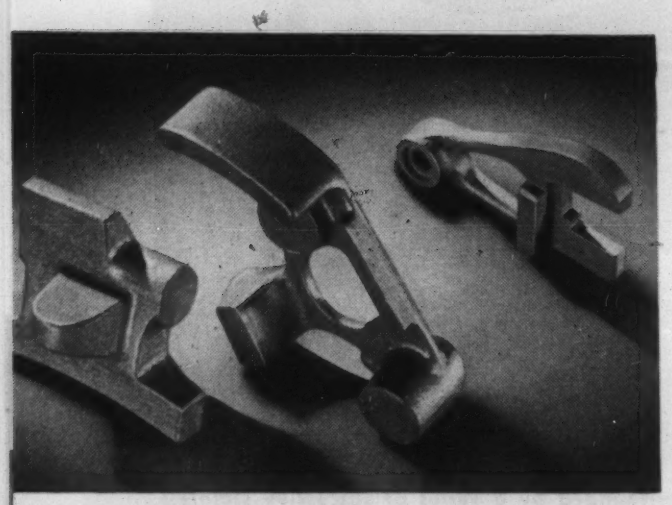
Another interesting feature of this production procedure is found in the extremely consistent wall thicknesses which are obtained. Following removal of the bottom of the cup, pieces can be elliptically formed to meet certain service requirements. As a result of the successful handling of the more difficult grades of stainless steel, the use of beryllium-copper drawing dies has been extended to other ferrous alloys including mild steel.

Flash Welding Electrodes

Flash welding, which is a method



Close-up of flash welder die assembly showing steel strip clamped in beryllium-copper die inserts ready for welding. (United States Steel Co.)



These beryllium-copper castings are used in the stock feeding mechanism of New Britain automatic screw machines to provide needed resistance to wear and impact.

for joining end-to-end two pieces of metal by passing an electrical current through abutting sections, is used extensively in joining lengths of strip, rod and tubing as well as in the production of a wide range of special items.

To make a flash weld, the two pieces of stock are clamped in current-carrying dies. By mechanical means, the two pieces of metal are brought into a position of light contact, so that the applied current produces an arcing action between abutting sections. As soon as arcing has heated the adjacent pieces of metal to the fusion point, the upset pressure, which extinguishes the arc and welds the parts together, is applied.

For best results, dies must resist wear and mushrooming and, at the same time, provide needed electrical conductivity. Although it was formerly customary to employ solid dies of aluminum bronze or equivalent materials, the use of beryllium-copper inserts for the contact or working surfaces has proven advantageous. The higher strength and increased conductivity obtainable with beryllium-copper, the standard RWMA Class 4 insert material, means longer life with reduced replacement costs for aluminum bronze dies.

Of perhaps equal significance is that flash produced during the welding cycle does not adhere to beryllium-copper as readily as to bronze or copper electrodes. This means less frequent dressing of the electrode by filing or grinding, thereby increasing production. At the same time, smoother and sounder welds are obtained.

As previously indicated, flash welding is employed in joining two pieces of metal end-to-end. Depending upon the nature and size of the electrode, either beryllium-copper dies or inserts can be used. Typical applications are found in flash welders located in steel pickling lines to produce continuous strips. Other applications include flash-butt welding of steel drums and barrels as well as the production of long lengths of rod, wire and tubing.

Although it may be advisable to use cast or forged beryllium-copper dies or inserts for special applications, many of the more standard inserts can be readily machined from hot rolled bar stock. By employing wrought material, a tougher and more uniform insert is obtained.

Parts in Automatic Screw Machines

To provide the needed combination of wear resistance and impact strength, beryllium-copper sand castings are specified at several critical points in New Britain's six-spindle automatic screw machines. The beryllium-copper parts, which are located in the stock feeding mechanism, include the following: switch operating lever, switch lever trip latch, spool reset cam and feed spool cam shoe. Three of these four parts are shown in the accompanying figure. The switch operating lever and switch lever trip latch function as an assembly to keep the switch closed.

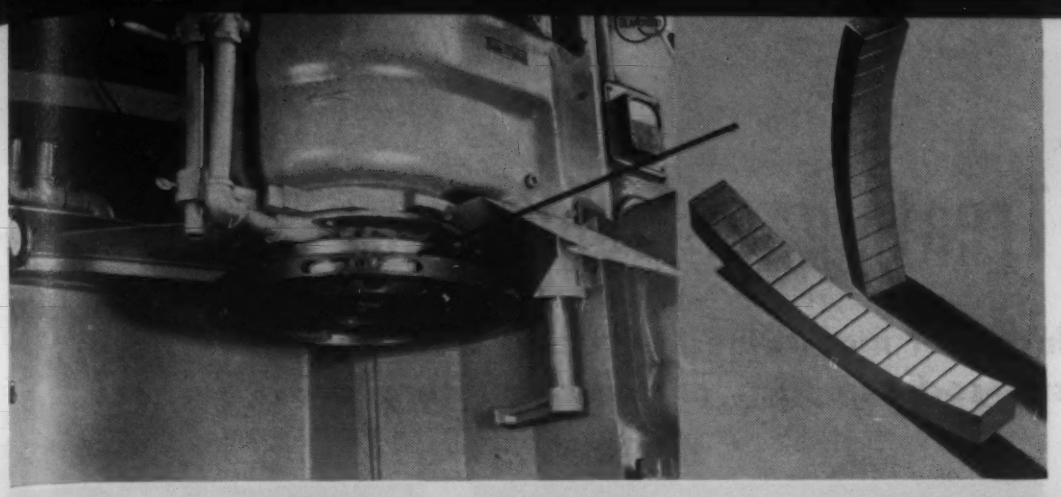
Since the parts contact the rotating steel spools, they must provide good wear resistance. Attempts to use various types of bronze and steel for the parts were unsuccessful, since these materials were found to fail either through wear or impact. Even when a heavy chromium plate was applied to steel castings, they still did not deliver the required life.

Beryllium-copper sand castings were tested and found to meet impact and wear resistance requirements. With some of the parts it was even possible to decrease the cross section without sacrificing wear or shock resistance qualities. By cutting down the weight, inertia was reduced and a more satisfactory indexing period resulted.

The beryllium-copper castings are furnished in the solution-annealed condition to permit finish machining and drilling. The parts are then given a simple, low temperature heat treatment to obtain a hardness of approximately 40 Rockwell C before assembly.

Grinding Machine Clamps

The Blanchard Machine Co. has recently introduced solid wheel holders on its surface grinders to provide more rapid wheel changing and to eliminate sulfuring. In designing this new feature, beryllium-copper has been selected for the spring clamps and full advantage has been taken of three of this material's unique charac-



Solid wheel holder on Blanchard surface grinder showing beryllium-copper spring clamps for gripping wheel. These beryllium-copper spring clamps provide the corrosion resistance, spring properties and the necessary non-magnetability.

teristics—spring properties, nonmagnetability and corrosion resistance.

These clamps, operating in slots in the wheel holder body, grip the wheel. The clamps are moved in and out by set screws which are fastened to the clamps and screw into tapped holes in the wheel holder body. Since the radius of the inner face of the clamp is less than that of the wheel, tightening of the set screw brings the center of the clamp firmly against the wheel, thereby applying approximately uniform pressure along the face of the clamp against the wheel.

The accompanying figure shows the solid wheel holder with clamps in place, and the beryllium-copper clamps themselves. Depending upon the model surface grinder, wheel holders may contain either three or five spring clamps.

Although steel served as the first clamp material, its magnetic characteristics attracted steel particles, causing the clamps to stick. By specifying beryllium-copper, the magnetic problem was solved. At the same time, beryllium-copper eliminated the need for cadmium plating the clamp to combat corrosion.

To meet operating conditions, the clamp must withstand high pressures when tightened and cannot relax with time. These needed spring characteristics were found in beryllium-copper in addition to the other requirements noted above.

For this application, beryllium-copper rectangular bar stock is specified. During fabrication, the bar is first cold formed into a ring with the end brazed together to facilitate machining. Following machining, the ring is cut into segments, which are drilled and tapped for the lock screw, and finally, the segments are heat treated to maximum spring properties and finish ground.

Seam Welder Wheel Bushings

In designing their line of seam welders, Thomson Electric Welder Co. employs beryllium-copper bushings to obtain the right combination of electrical conductivity and wear resistance. These rather critical bushings not only carry the entire welding current but also retain the wheel shaft.

Depending upon the model and type of work, the bushings may either straddle the wheel, as in the case of longitudinal welding, or for outboard wheels, the bushings are spaced apart on the shaft inboard of the wheel. Bushings are pressed into the arm which carries the current from the transformer. In turn, the bushings transmit the current to the shaft to which the welding wheel is bolted.

Since the shaft is easier to replace than the bushing, a harder material is employed in the bushing to insure longer life and reduce maintenance. In addition to usual mechanical wear between the chromium-copper shaft and the beryllium-copper bushing, pitting may result from arcing caused by the passage of current between bushing and shaft. A relatively loose fit is needed to prevent freezing, while friction must be carefully controlled; otherwise the idler wheel may stick and wear flat.

To meet a wide variety of operating conditions, current loads may range from 15,000 up to as high as 70,000 amp. At the same time, pressures on wheels run from 500 to 4500 lb. Where higher pressures may be encountered (up to 6000 lb), it becomes necessary to replace the bushing construction with roller bearings. These bearings consist of rollers fabricated from beryllium-copper rod stock and a cast beryllium-copper cage.

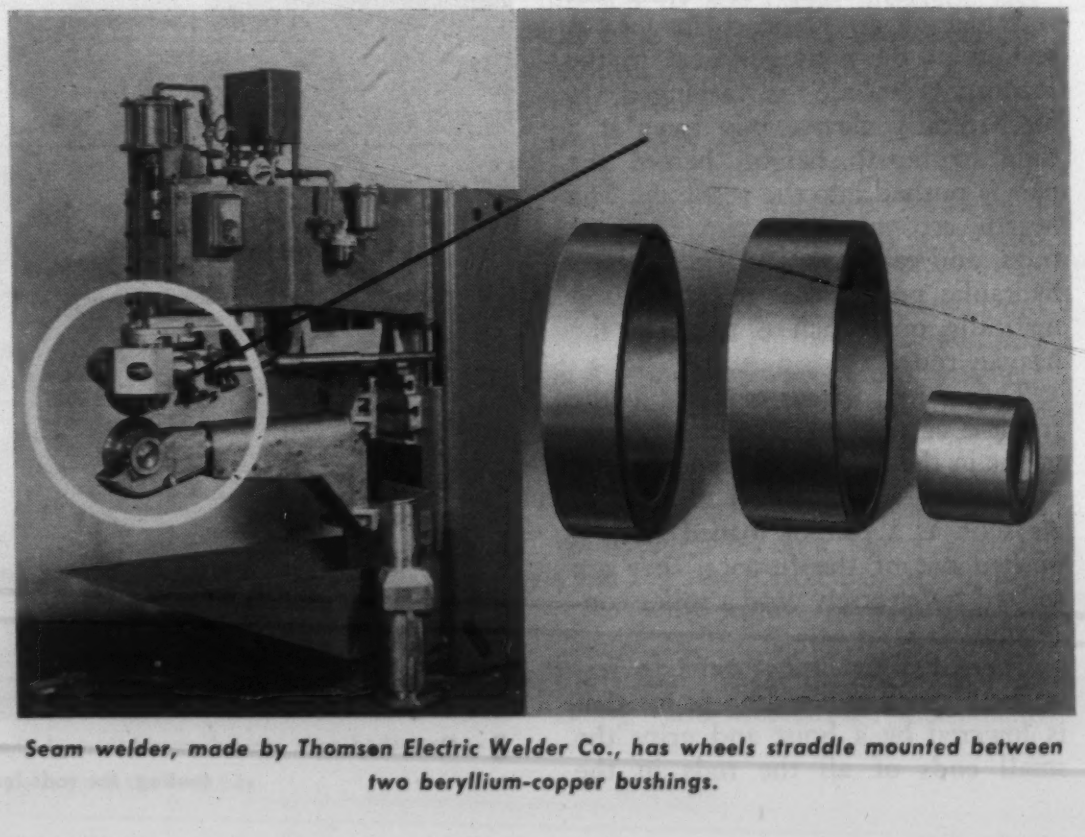
Bushings are generally sand cast. They are then solution annealed, rough turned and precipitation hardened for 3 hr at 600 F. Finally, bushings are finish turned to size and oil holes added.

These are but a few of many similar uses of wrought and cast beryllium-copper in production equipment. The growing list of similar applications includes machine parts in the following fields; container and packaging, textile, paper, chemical, petroleum, mining, ordnance and others.

Acknowledgment

The author acknowledges the assistance of the following firms in providing data and illustrations used in this article:

Blanchard Machine Co.
Mesta Machine Co.
New Britain Machine Co.
Thomson Electric Welder Co.
United States Steel Co.
United Tool & Die Co.



Seam welder, made by Thomson Electric Welder Co., has wheels straddle mounted between two beryllium-copper bushings.

Production Heat Treating of Connecting Rods

by HERBERT CHASE

High output maintained by using a continuous furnace, caustic soda quench and recirculating draw furnace.

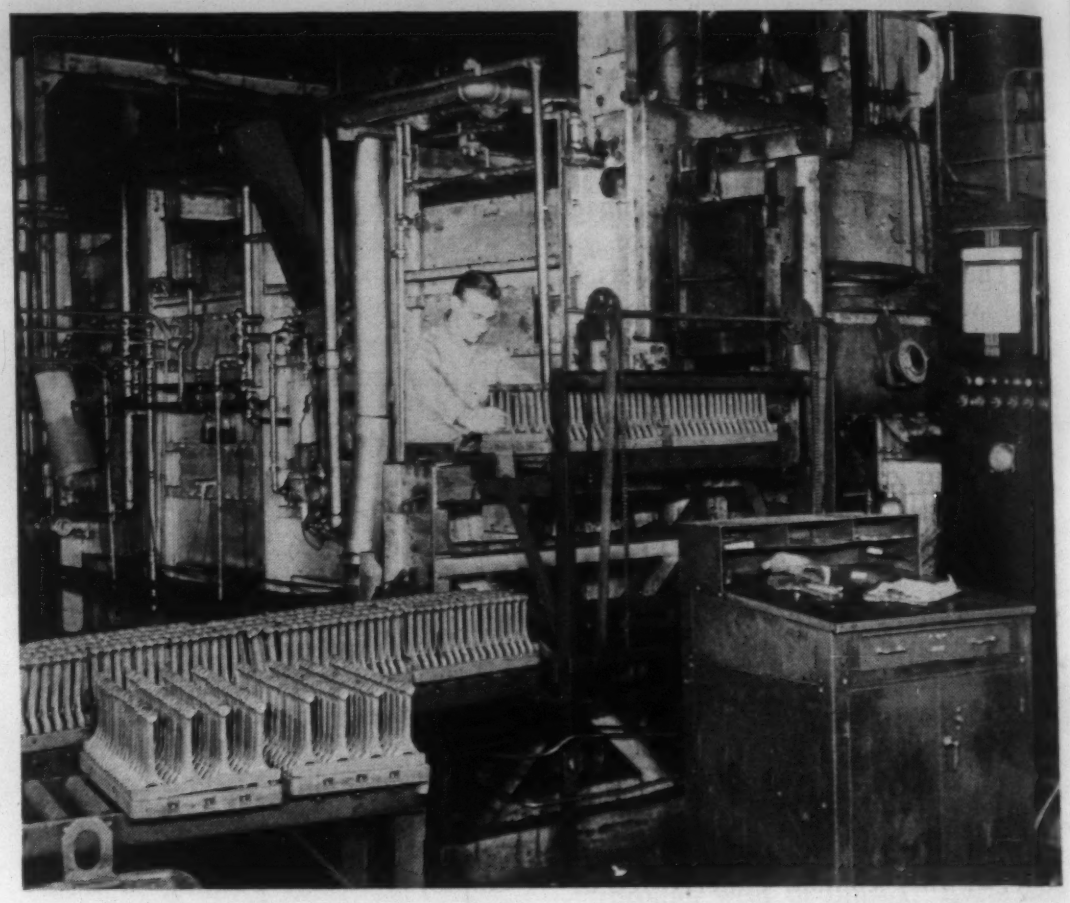
● CONTINUOUS FURNACES are not common in plants that do heat treating on a jobbing basis. A pair of such furnaces is being employed successfully in at least one such setup, however. Although adaptable to a large variety of work, including dry cyaniding and case carburizing in controlled atmospheres, the furnaces have been used especially in clean hardening connecting rods for automotive engines on a high production basis.

Although the Surface Combustion hardening furnace is provided with an RX generator of the same make to supply controlled atmospheres, no control of atmosphere is needed in the rod job dealt with here. The furnace is of the radiant tube type and of gas-tight construction. Since it is equipped with vestibules, there is little air motion or infiltration. Only light scale is formed, and this is removed in a caustic quench, leaving the product substantially scale free.

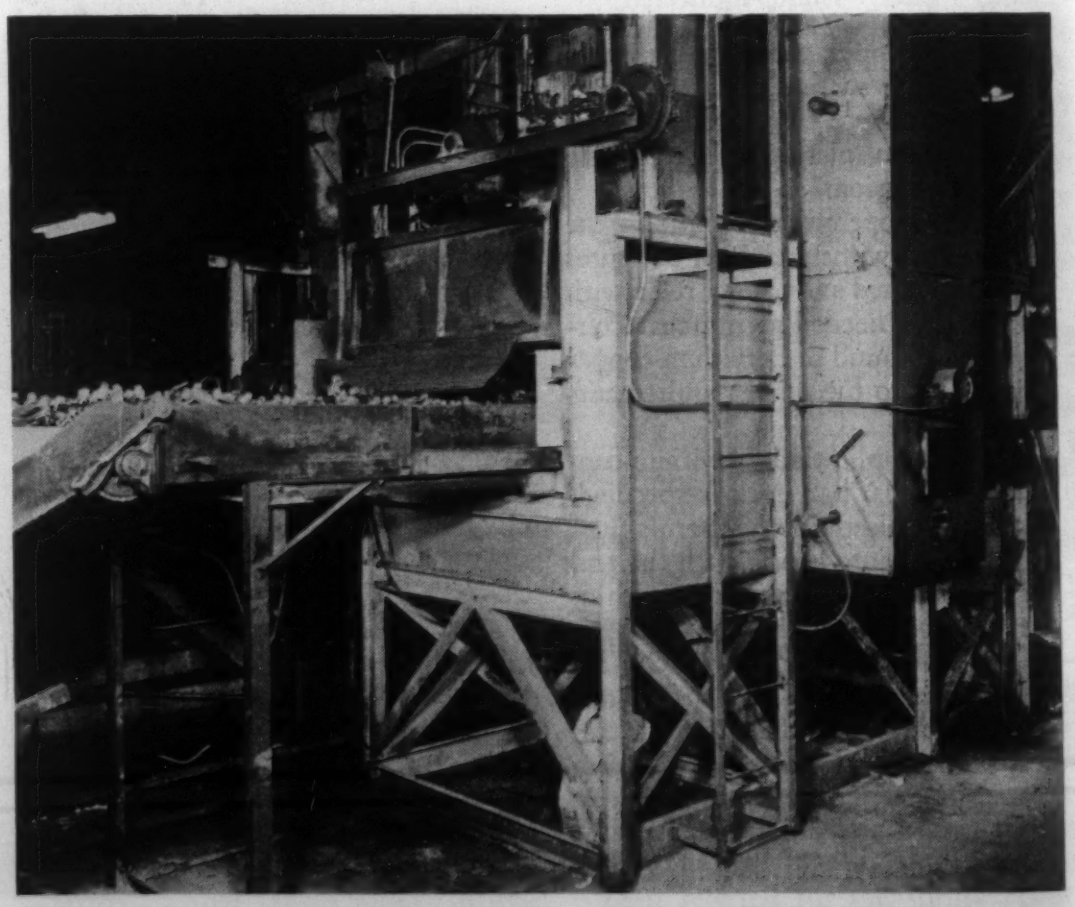
Rods are received with bolts pressed in holes and are ready to load directly from the tote boxes. This loading is done by hand in heat resistant alloy trays that weigh 50 lb each and hold four rows of 15 rods, or a total of 60 rods. Some of the rods weigh 18 oz each and others 28 oz each. Roller conveyors for tray loading are at bench height. A section of the conveyor next to the loading vestibule is arranged to mechanically elevate two trays at a time to hearth height, before the pair is pushed into the vestibule. The hearth accommodates two rows of trays, and each row is advanced by a hydraulic pusher that operates automatically once each 6 min for the heavier rods.

There are 24 trays of parts in the furnace at one time. Each tray remains in the furnace 72 min, and the loads attain a temperature of 1550 F. As soon as a pair of loaded trays is pushed out of the furnace, they are shifted transversely onto a roller conveyor.

There the two trays come to rest under a special unloading frame that is lowered by a hoist and grips the small ends of all the rods in the



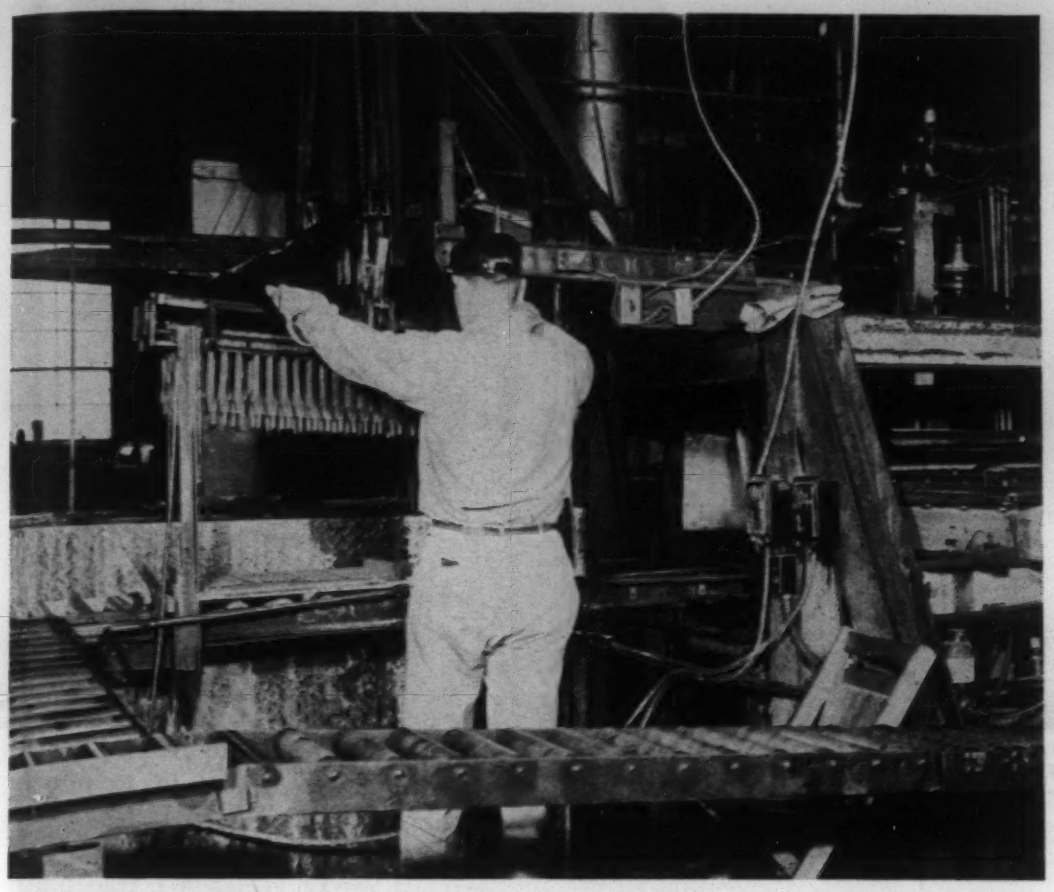
1 *Trays of connecting rods are elevated to be pushed into the hardening furnace. No controlled atmosphere is required in the furnace.*



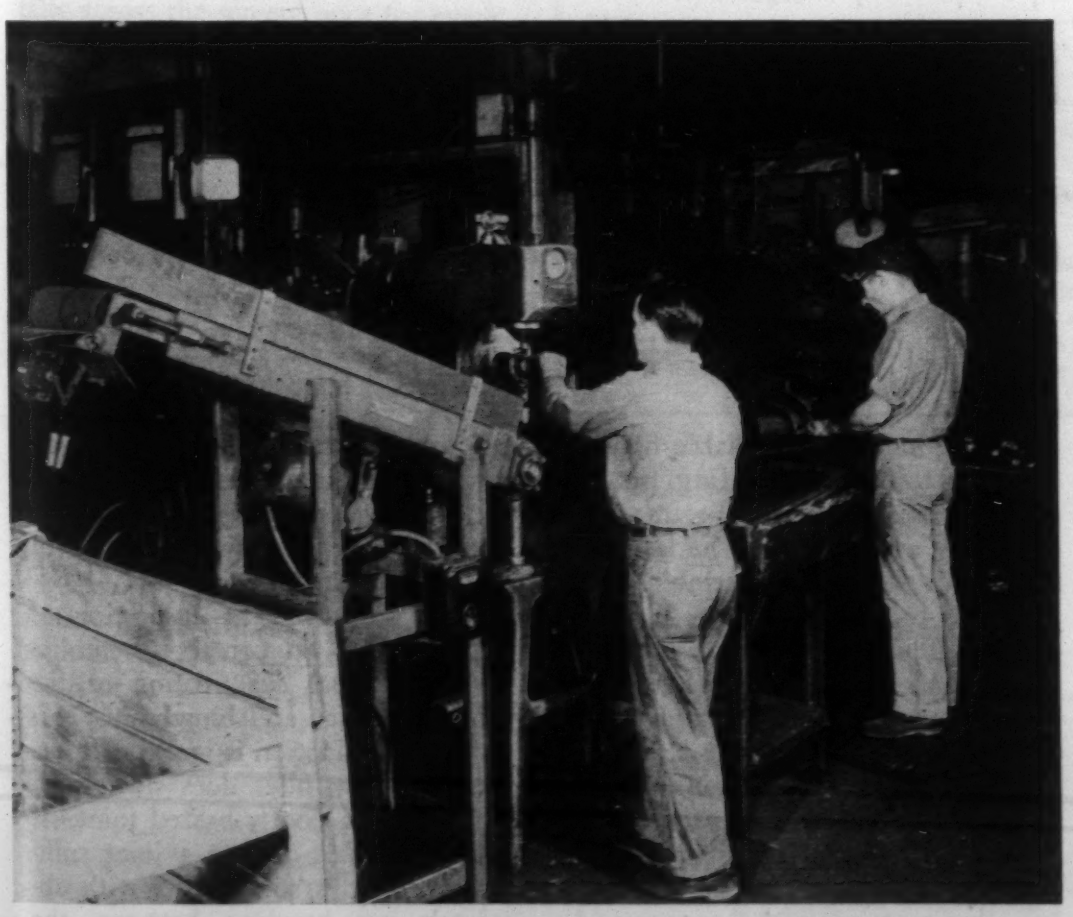
3 *Quenched rods are advanced through the draw furnace on a belt conveyor. After water cooling, the rods feed down the chute at left.*

four rows and lifts them free of the trays. The load is then shifted along a rail and lowered into the 10% caustic soda solution in the quench tank. This solution is circulated and cooled to a temperature of 106 F. The load remains submerged for 10 to 14 sec.

The load, still held by the rack, is then shifted further along the rail and dropped onto the wire mesh belt conveyor that feeds the draw furnace. With this arrangement, the trays that carry rods through the hardening furnace do not enter the quench. After unloading, they are released and move down a set of inclined roller conveyor sections and then along a level section of roller conveyors back to the reloading area.



2 *Rods heated to the quenching temperature are lifted from the trays, then lowered into the caustic quench. Trays return for reloading on roller conveyors.*



4 *A spot is ground on each rod, and the man at left Brinells rods in groups of three. The belt conveyor delivers rods to the tote box.*

As soon as a load of rods comes out of the hardening furnace, a pilot light is switched on and remains on under timer control for 30 sec. Rods must be quenched before this light is shut off. If there is any delay beyond this time, the rods, instead of being lowered into the quench, are lowered again into the trays from which they were taken and are returned on the tray conveyor for recycling through the hardening furnace. This prevents quenching from too low a temperature.

The quenched rods feed slowly through the draw furnace, remaining in it for 50 min to be heated to 800 to 880 F. Then they pass through cooling water and are discharged onto a short chute to a station where a spot is ground off of each rod for Brinelling.

The draw furnace was designed as a pusher type but has been converted to use a woven wire belt. Natural gas is used as fuel in the draw furnace as well as in the hardening furnace. Combustion in the draw furnace occurs in a chamber at the top, and products of combustion are recirculated by fans in the upper portion of the furnace.

After rods slide down the chute from the draw furnace, they are picked up one at a time and a spot is ground on each. Then the rods are passed down a short incline to an inspector who Brinells each to see that hardness is in the specified range of 303 to 305. The inspector lays the rods on a short inclined belt that elevates them and discharges them into a tote box. As each set of three rods passes over a balanced plate at the end of the belt conveyor, the plate is deflected downward and momentarily actuates a counter to keep tally on output.

Only four men are required, and two of them perform the grinding and inspection operations. Where grinding and inspection of every piece are not needed, three men or even two can handle the setup. There is thus considerable flexibility, while long runs on a large volume of parts are also handled to best advantage. Uniformity in treatment is assured by the automatic features of the setup. These include both indicating and recording instruments with suitable automatic controls and timing.

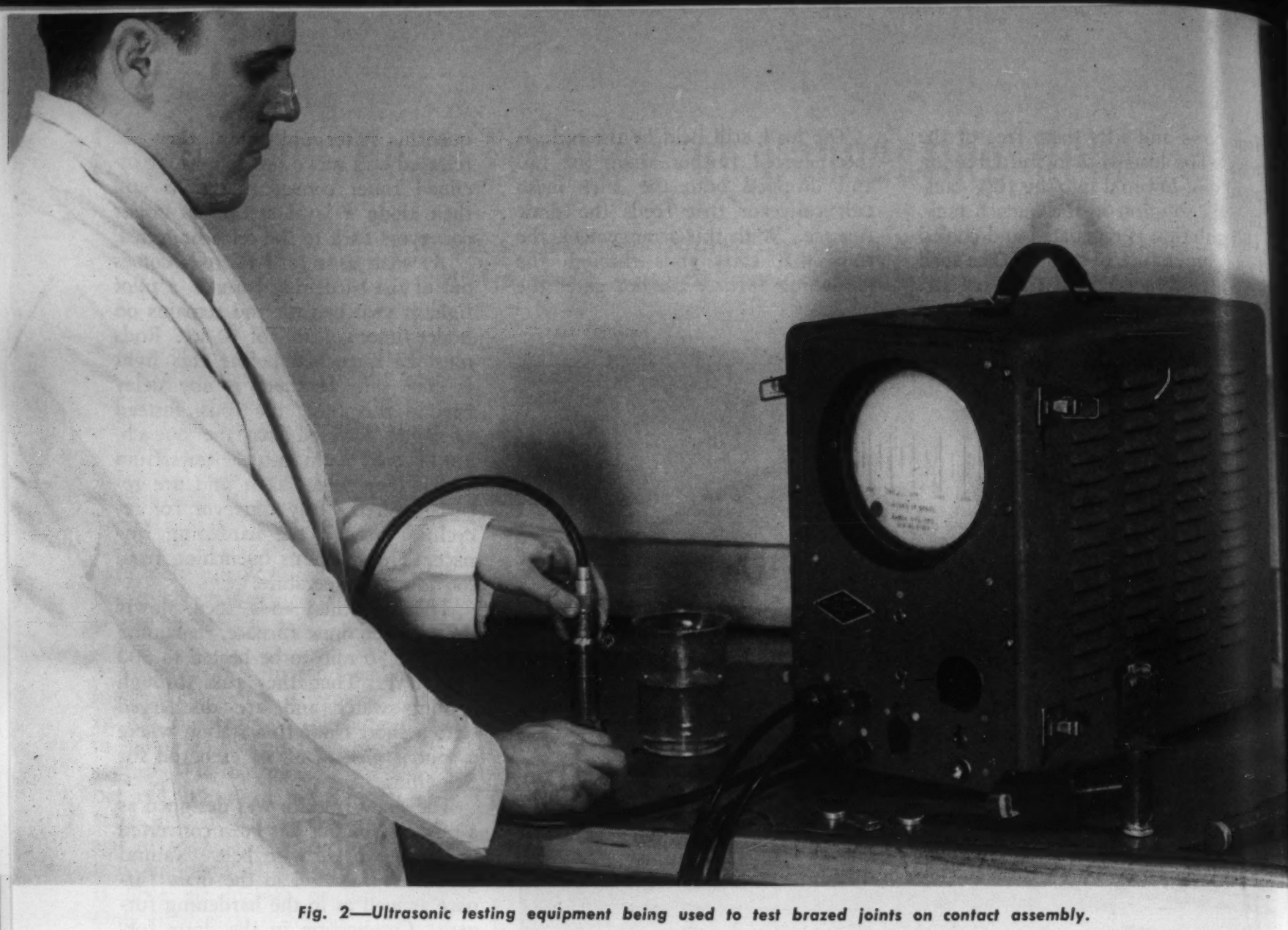


Fig. 2—Ultrasonic testing equipment being used to test brazed joints on contact assembly.

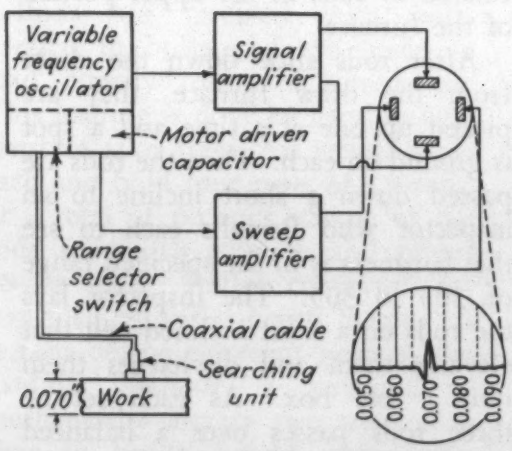


Fig. 1—Schematic diagram showing essential components of the Reflectogage.

Ultrasonic Inspection Checks Quality of Brazed Joints

by **H. GREENBERG**, Materials Engineering Dept., Westinghouse Electric Corp.

Good correlation between shear testing and ultrasonic inspection resulted in adoption of this nondestructive test method for brazed circuit breaker contacts.

● THE NEED FOR A reliable nondestructive test for inspecting brazed circuit-breaker contacts became increasingly apparent over the last few years because contact assemblies are subjected to severe impact and high voltage arcing in service, and their integrity must be assured at all times. The contact material commonly used is an alloy containing 65 tungsten and 35% silver. The brazing operation is quite critical, and particularly so when brazing silver-tungsten contact tips to Cupaloy (an age-hardening alloy containing 99.5 copper and 0.5% chromium) parts because of the inherent poor wetting of silver-tungsten and the necessity of keeping the brazing temperature to a minimum to avoid excessive softening of the Cupaloy stem.

Prior to 1950, the inspection of brazed joints on contact assemblies involved visual examination of the fillets for voids and blowholes. This type of examination is inadequate because a gassy fillet does not necessarily mean a poorly brazed joint. It is also possible to heat a joint sufficiently to get a sound fillet with absolutely no bonding between the silver-tungsten tip and underlying

Cupaloy stem. Consequently, a certain amount of shock testing, partly destructive, was also used.

During the past four years ultrasonic inspection techniques using a Reflectoscope have been developed to the point where this method is now a routine tool for the inspection of rotors, thrust-bearing shoes, turbine disks, and miscellaneous forgings of all types. Experiments were also conducted with the use of the Reflectoscope for the inspection of brazed joints in contact assemblies, but test results were inconclusive primarily because of the small section thickness of the assemblies being tested.

Test and Procedure

Preliminary tests made with the Reflectogage, another ultrasonic instrument originally used to check the thickness of hollow steel aircraft propellers, indicated that this instrument could probably be adapted to the inspection of brazed joints. A schematic diagram of the components of the Reflectogage is given in Fig. 1. In practice, the quartz crystal of the searching unit is applied to the surface of a part previously coated with a film of glycerine or oil to insure introduction of maximum ultrasonic energy. The rotation of the tuning condenser constantly varies the frequency of the oscillator over its tuning range. At the same time, the cathode-ray beam is swept horizontally across the screen, once for every revolution of the condenser. Whenever the changing frequency emitted by the crystal coincides with the natural freqency of the part, resonance occurs.

As the part resonates, momentary changes in electrical energy supplied to the crystal will cause vertical indications (pips) to appear in the cathode-ray beam. The position of the pips on the horizontal axis of the beam is a direct indication of the resonant and harmonic frequencies of the material being tested. Since the natural or resonant frequency of any mechanical part is a function of its thickness, density and elastic modulus, the location of the pips may be interpreted as a thickness measurement of a given material in those cases where the latter two variables are held constant. For example, the Reflectogage screen pattern, in a given range, contains six pips for a $\frac{1}{2}$-in.-thick section and 12 pips for a 1-in. thick section. If the two sections are intimately joined together by welding or brazing, the Reflectogage screen pattern will then contain 18 pips, which is a pattern identical to that obtained from a $1\frac{1}{2}$-in.-thick section. This is the principle by which the quality of brazed joints can be evaluated using the Reflectogage.

Although the Reflectogage is equipped with four crystals having different frequency ranges, the "red" crystal having a frequency range of approximately 1.3 to 2.6 megacycles-per-sec has been found most suitable for testing brazed joints. Fig 2 shows the Reflectogage being used to test brazed joints in a contact assembly. Although various styles and types of contacts have been tested successfully, this article describes the details of ultrasonic inspection on only one particular contact assembly. This consists of a Cupaloy stem to which are brazed silver-tungsten tips, one end having a 1-in. dia by $\frac{1}{4}$-in.-thick tip and the opposite end a 1- by $\frac{3}{4}$- by 21/64-in. thick tip.

Before testing brazed assemblies, the operator must first obtain the

Correlation of Ultrasonic Inspection with Destructive Shear Testing of Brazed Joints in Contact Assemblies

Ultrasonic Rating→	Excellent	Good	Poor	Bad	Very Bad
Shear Test Results, Psi	27,100	19,800	20,600	11,900	12,500
	22,600	15,900	19,400	14,300	3,310
	26,300	17,300	17,200	12,700	1,820
	25,600	22,500	21,700	17,200	12,700
	20,000	20,200	17,200	18,700	12,700
	21,600	19,600	17,100	17,000	13,600
	15,700	20,700	16,300	15,900	6,700
	19,400	17,100	21,700	18,300	16,000
	23,800	19,700	16,900	15,900	2,700
	28,200	19,000	16,900	15,700	5,300
	22,400	19,300	14,800	15,200	
	19,900	14,100	14,900	17,300	
	25,100	17,800	14,100	17,300	
	27,500	14,500	15,600	19,700	
	27,300	18,500	17,200	21,100	
	23,800	15,900	13,300	17,900	
	32,600	20,500	19,300	16,200	
	24,200	23,500	20,000	17,500	
	28,300	20,500	19,300	11,500	
	29,500	16,800		11,500	
	28,800	22,400			
	28,700	21,400			
	25,300	21,200			
	27,900	24,700			
	24,800				
	17,700				
	29,800				
Average	25,000	19,300	17,690	16,100	8,700
Standard Deviation	4,200	2,700	2,400	2,700	5,000

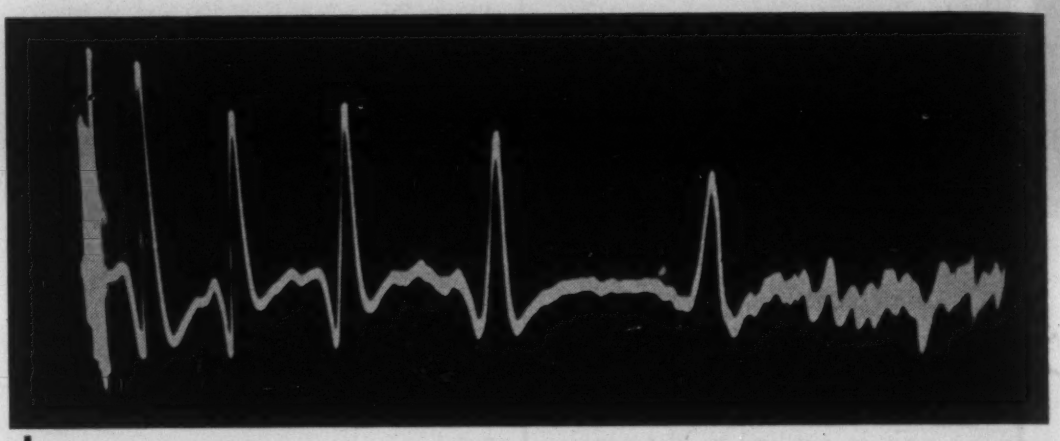
Advantages and Disadvantages of Ultrasonic Testing Brazed Contacts

Advantages	Disadvantages
1. Test is nondestructive.	1. Although experiments are now being conducted with small crystals, commercially available quartz crystals are a little too large for exact ratings of poorly brazed (borderline) assemblies.
2. Brazed joints can be evaluated on a quality control basis.	2. The contact tips must have parallel surfaces.
3. The location of poorly bonded areas can be determined without destroying the assembly.	3. Ultrasonic inspection gives no indication of the thickness of the joint. Joints may be rated as good, and nevertheless show low shear strengths because the shear strength of brazed joints decreases sharply with increasing joint thickness above 0.0015 in.
4. The test method is rapid and inexpensive.	

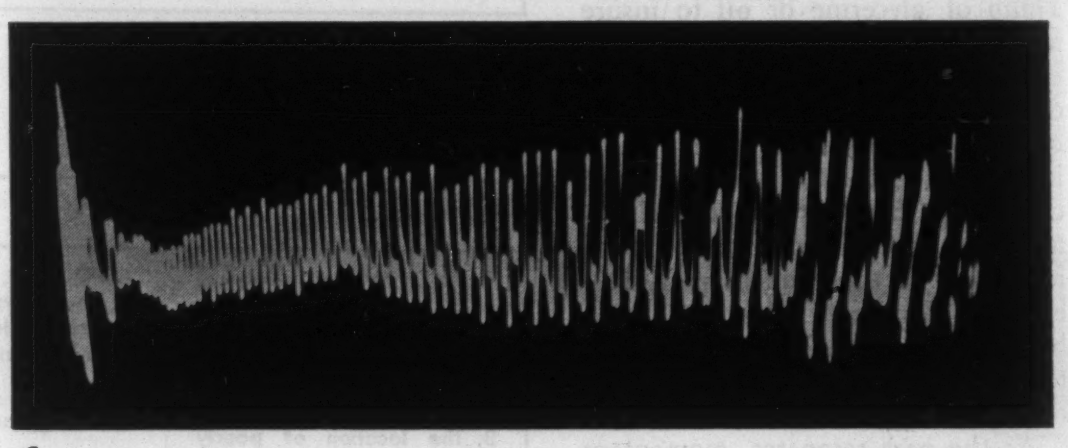
characteristic oscilloscope pattern of the two contact tips and of a solid bar of copper having the same overall length as the contact assembly. These characteristic patterns are shown in Fig 3. The pips in each case represent either the natural frequency of the part being tested or harmonics of this frequency. As shown in the patterns, the thicker the section, the closer together are the pips representing the harmonic frequencies.

Having studied the size and location of the pips in the characteristic pattern of the unbrazed contact tip, the operator can proceed with the inspection of brazed assemblies. If the oscilloscope screen reveals the characteristic pattern of the contact tip while the crystal of the searching unit is being moved across its surface, a large unbrazed area is present between the tip and the Cupaloy stem (Fig 4a). This unbrazed area can be plotted quite accurately provided the quartz crystal is not much larger in diameter than the defective area. If the unbrazed areas are relatively small in comparison to the size of the crystal, the pips will be shorter but will always appear at the same location on the horizontal axis as in the characteristic pattern of the tip (Fig 4b). When small randomly distributed pinholes are present in the brazed joint, the pattern will approximate a horizontal line with practically no pips (Fig 4c). As shown in Fig 4d, perfectly brazed joints having no voids in the braze will give a pattern approximately the same as that of a solid bar of copper having the same overall length as the brazed contact assembly.

a



b



c

Fig. 3—Characteristic Reflectogage patterns: (a) 1-in. dia., ¼-in. thick silver-tungsten contact. (b) 1- by ¾- by 21/64-in. thick silver-tungsten contact. (c) 4-in. length of copper rod.

Correlation with Shear Test

In order to test the accuracy of this inspection method, numerous brazed assemblies were rated by ultrasonic inspection techniques and then shear tested. By this means, not only was a correlation obtained between shear testing (destructive) and ultrasonic inspection (nondestructive), but also the size and distribution of unbrazed areas could be examined visually.

Fig 5 shows the correlation between shear testing, ultrasonic inspection, and area of good bonding. It should be pointed out that the Reflectogage ratings of the rectangular tips were made on the basis of their entire areas while only the center portions were shear tested. Some of the discrepancies in this photograph may have been the result of excessively thick joints; the shear strength of brazed joints decreases sharply with increasing joint thicknesses above 0.0015-in. This testing was done early in the testing program and was considered sufficiently good correlation to warrant further investigation of ultrasonic inspection techniques.

Many more samples were rated ultrasonically and then shear tested. A correlation between shear testing and ultrasonic inspection is given in the table. The correlation between the two testing methods is quite good, although there is some overlapping in the various classifications. In practice, the brazed joints are merely rated excellent, good or bad; rejectable joints include the last two classifications of the table.

One must take into consideration, while studying the table, that ultrasonic inspection of brazed joints is a new tool, and that the testing methods and evaluation of results are constantly being improved. The data presented in the table were collected over a period of seven months, during which time constant refinements in testing procedure were introduced.

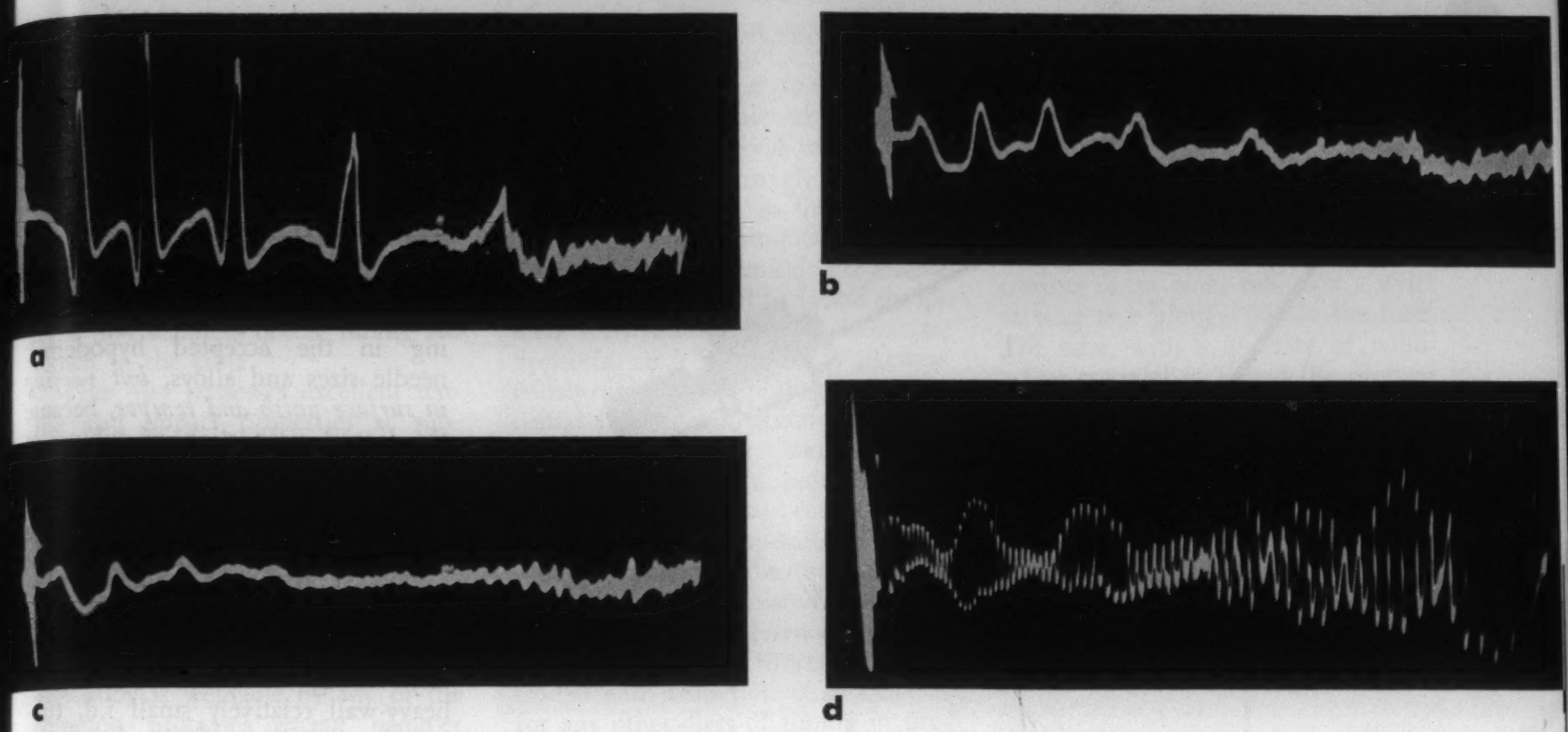


Fig. 4—Screen patterns of brazed joints between 1- by ¾- by 21/64-in. thick silver-tungsten contacts and Cupaloy stems. (a) Very bad joint. (b) Poor joint. (c) Good joint. (d) Excellent joint.

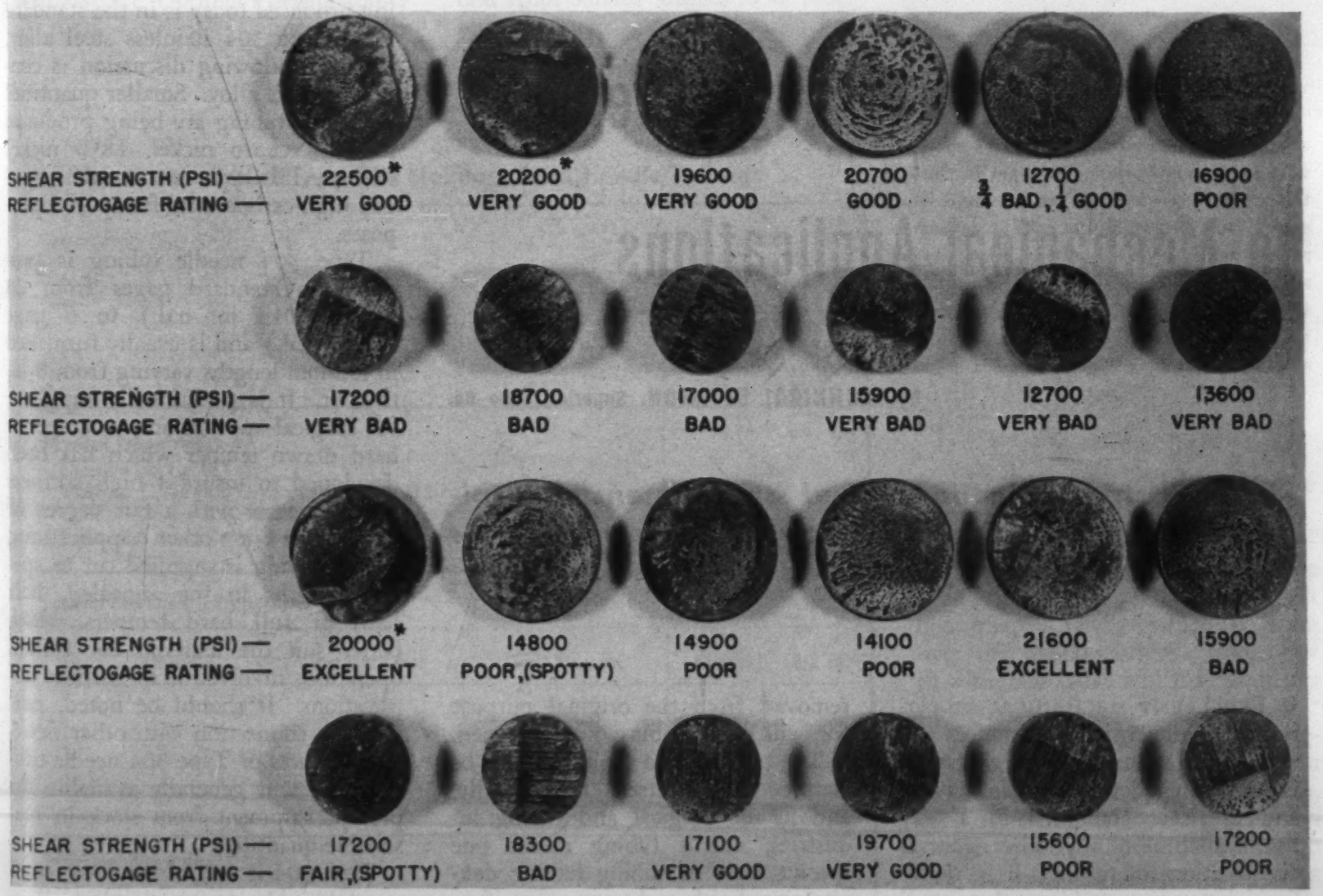
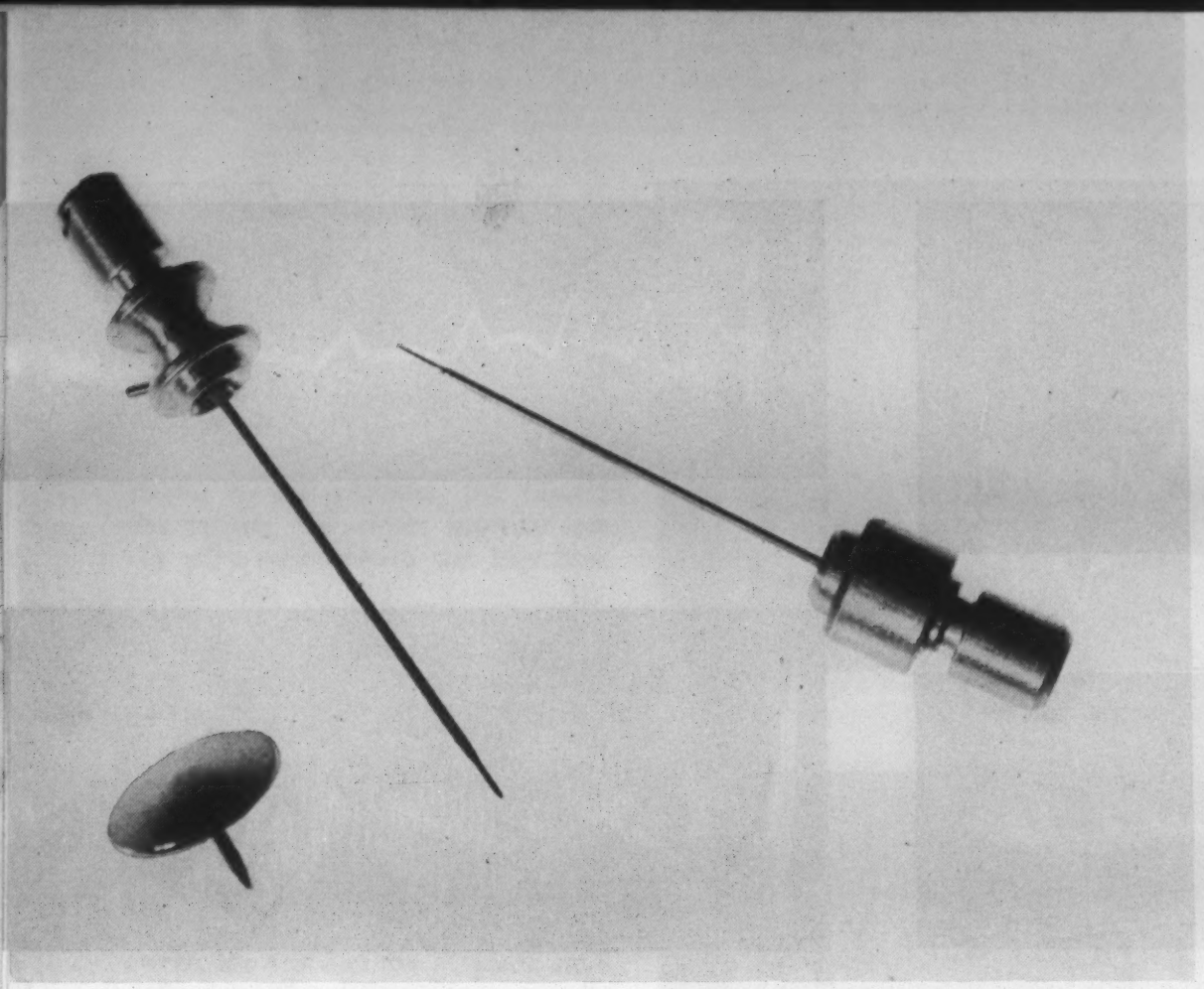


Fig. 5—Correlation of shear strength, ultrasonic inspection and appearance of contact tips. The smaller round was machined from the rectangular tip before shear testing but after ultrasonic inspection. The asterisk indicates fracturing of the Elkonite tip.



Needle tubing is used as the adjusting pin in insect bombs. For this application, one end of the tube must be reduced and the other end bent. The thumb-tack (lower left) indicates the relative size of the parts. (Knapp Monarch Co.)

Use of Needle Tubing Extended to Mechanical Applications

by **TECHNICAL DIVISION, Superior Tube Co.**

The high strength, stiffness and strict dimensional tolerances characterizing this tubing open new fields for a product originally designed for surgical uses.

● EXCELLENT MECHANICAL properties, strict dimensional tolerances and exceptional cleanliness are characteristics of hypodermic needle tubing, and they are combined in a way not available in any other general classifications of tubing. It is, therefore, interesting to note that engineers in a variety of fields are turning to this product for applications far removed from the original purpose for which the tubing was designed.

The term needle tubing should be clarified at the outset. Traditionally, and in the surgical and tubing industries, needle tubing means one specific class of tubing having definite size, finish and temper specifications in various alloys. Needle tubing can be ordered in any one of about 23 sizes and in any one of several alloys (as indicated below). However, finish and temper (high tensile strength and stiffness) generally define the class itself. It was developed for one use only: to introduce fluids through the skins of humans and animals.

For purposes of this discussion, however, the definition will be altered to include precision small tubing in the accepted hypodermic needle sizes and alloys, *but varying in surface finish and temper,* because the largest proportion of tubing in needle grades and sizes which is now being supplied for mechanical applications is not supplied in the needle temper. It should be noted that needle tubing used for capillary purposes has been called capillary tubing. This is a misnomer, since capillary tubing is a definite class of heavy-wall relatively small i.d. tubing developed specifically for capillary functions.

Properties of Needle Tubing

With the wider, somewhat looser definition of needle tubing in mind, its specific properties can be defined. The largest percentage of needle tubing produced today is in the standard AISI Type 304 stainless steel alloy, and the following discussion is confined to this alloy. Smaller quantities of needle tubing are being produced in 30% cupro nickel, 18% nickel silver, AISI Type 420 stainless steel and high carbon steel for special purposes.

Type 304 needle tubing is produced in standard gages from 28 gage (0.014 in. o.d.) to 6 gage (0.203 o.d.) and is usually furnished in random lengths varying from 8 in. to 6 ft. It is traditionally supplied, for surgical applications, in a special hard drawn temper which has been developed to insure a high stiffness level, together with a fair degree of ductility. For other applications, needle tubing is supplied cut to specific lengths in the annealed, half hard or full hard tempers which better suit the material for certain operations involved in mechanical applications. It should be noted, perhaps, in connection with other desirable features of Type 304 needle tubing, that it is generally available for prompt shipment from stock in reasonable quantities.

Type 304 is one of the most commonly used austenitic stainless alloys in tubular form. Like the other austenitic grades, it is fully corrosion re-

sistant only in the completely annealed condition, but can be used in the harder tempers for many applications where corrosion is not severe. While Type 304 cannot be hardened by heat treatment, a wide variety of mechanical properties are developed by cold drawing. Typical mechanical properties, physical properties and chemical composition of Type 304 seamless needle tubing are shown in the table.

Type 304 possesses excellent tensile and impact properties at subzero temperatures and has been used at temperatures as low as —300 F. At the other end of the temperature range, scaling resistance is excellent in continuous service up to 1650 F, and for intermittent service up to 1450 F.

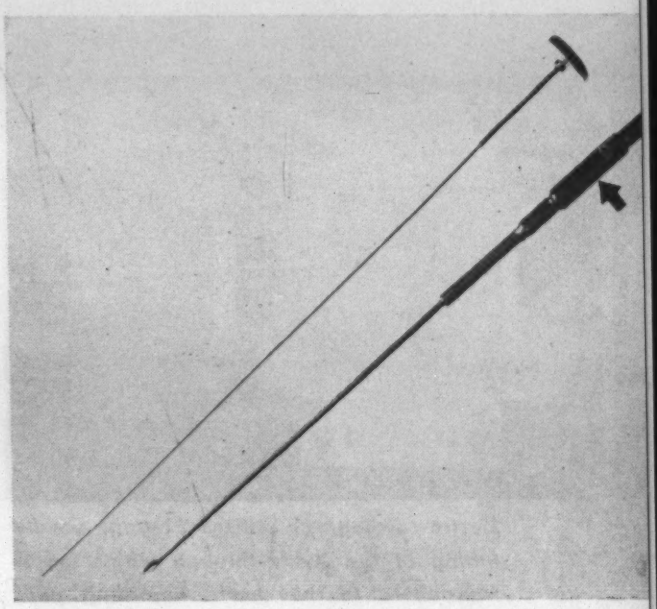
Needle tubing supplied in Type 304 alloy is weldable by any of the common processes except hammer and forge welding. It can likewise be soft-soldered and brazed. Silver brazing of hard drawn needle tubing may be attended by formation of cracks. This difficulty can be circumvented by use of special silver brazing alloys having a high flow point. Consultation with a supplier is advisable. Optimum machinability of AISI Type 304 stainless needle tubing is obtained in approximately ¼ hard temper.

Resistance of Type 304 tubing to corrosion by organic or inorganic acids varies from good to excellent. The alloy is extensively used (in larger tubing sizes) in the handling of food and milk products, heat exchanger tubes, chemical processing equipment, structural parts and equipment for handling organic chemicals, dyestuffs, etc. The alloy is likewise widely used in surgical instruments, dental instruments, automatic pencil parts, thermometer wells, watch bracelet parts and a host of other applications requiring corrosion resistance at room temperature.

Hypodermic needle tubing is a precision product manufactured to close dimensional tolerances. Chemical composition is thoroughly controlled and inspection is as strict as for any other class of tubing in production today. Both inside and outside surfaces are exceptionally clean, bright and devoid of flaws in order to permit free, non-contaminating passage of fluids. Hypodermic needle tubing is packed with great care and sealed for shipment to the user in such a way as to reduce contamination from outside sources to an absolute minimum.

New Uses Summarized

It might be expected that any expansion of the applications of needle tubing would eventually include wider use in the surgical and dental fields. Typical of a number of surgical applications is the use of 15 gage tubing as a radon implanter which consists of an outer tube and a stylet serving as a plunger inside the tube. The tube, with a quantity of radioactive material in it and the plunger retracted, is inserted into the body where the radioactive destruction of malignant tissue is required. When the point of the needle reaches the desired area, the plunger is pushed down and the radon seeds are planted.



Radon implanter consists of an outer tube and an inner stylet or plunger. The tube is inserted into the body until the point reaches an area of malignant tissue. Radon seed which has been placed in the loading slot (arrow) is planted by pushing the plunger. Hypodermic needle tubing, type 304, needle temper, 15 gage is employed in this application. (Radium Emanation Corp.)

Among the more recent dental applications is the use of 10-gage needle tubing as saliva ejector, a hook-shaped device which is hung over the dental patient's lower jaw to withdraw saliva which accumulates in the mouth.

Wide use of needle tubing is developing for use as tips and fountain parts in continuous inking apparatus, such as recorders, fountain pens and similar devices. Several products on the market today utilize this tubing in an interesting, somewhat similar way, as nozzles through which minute quantities of lubricating oil are

Properties of Type 304 Stainless Steel Needle Tubing

Composition, %	C, 0.08 max Mn, 2.00 max Si, 1.00 max P, 0.04 max S, 0.03 max Cr, 18.00–20.00 Ni, 8.00–11.00
Physical Properties	
Density Lb/Cu In.	0.286
Thermal Cond Btu/Hr/Sq Ft/Ft/F @ 212 F	9.4
Coef of Esp per F (0–600 F)	9.6 x 10–6
Elect. Res Microhm-Cm @ Room Temp	72

Typical Mechanical Properties

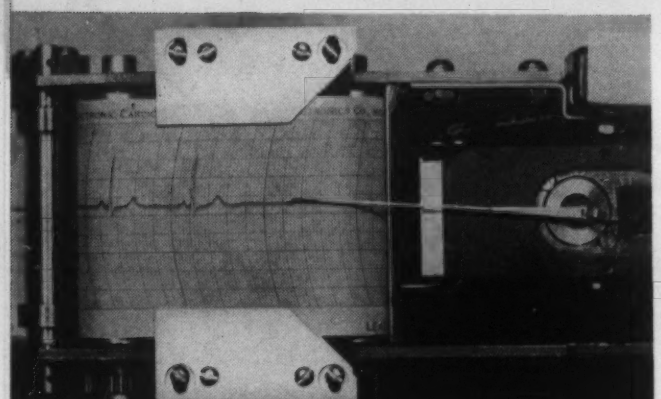
Temper	Tens. Str., Psi	Yld. Str., Psi	Elong. % in 2 In.
1	105,000	40,000	40
2	135,000	95,000	15
3	160,000	120,000	5

Machinability Index (Free-Cutting B1112 Steel—100%)	40–50%
Scaling Temp for Continuous Service, F	1650

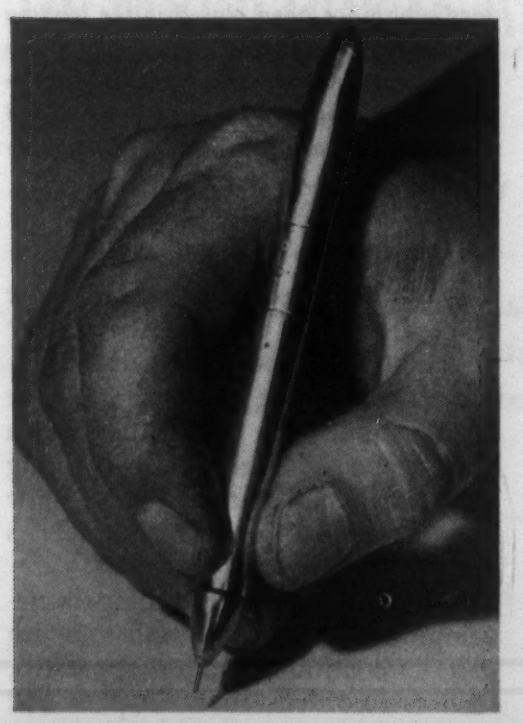
applied to watches and other delicate instruments. Needle tubing has found an interesting application in microchemical work for the dispensing of minute and accurate quantities of chemicals. It is likewise used as x-ray collimating tubes.

Further uses for needle tubing which have been reported are as pitot tubes and manometer lines in laboratory equipment, certain types of phonograph pick-ups, and injection parts in automatic electrical ampule filling machines.

It should be noted in connection with many of the new uses of needle tubing that fastening of the tubing to other components by soldering or brazing is necessary. (See precaution on silver brazing mentioned earlier.) In many of the more recent applications, tubing must be flanged, expanded, flattened, beaded, bent and otherwise deformed. Because of the wide range of forming and joining possibilities, it is very desirable to consult with the mill supplying the tubing in order to obtain the product best suited for the application in prospect. This is particularly important when it is recalled that Type 304 stainless steel, like all austenitic grades, work hardens rapidly. It should, therefore, be ordered for the job that is to be done—*e.g.* for severe deformation, fully annealed material should be specified. For moderate forming (bending, flattening, flaring), intermediate tempers such as ¼ hard or ½ hard may be satisfactory.



Electro-cardiograph utilizes 21-gage needle tubing in the stylus through which ink is transmitted to the chart. Recording pens vibrate at 15 cycles per sec, must be stiff and have excellent fatigue resistance. Needle temper is specified. (Edin Co.)



The point of this new fountain drafting pen is type 304 needle tubing. The pen is reported to produce fine, uniformly inked lines for engineering drawings. (Tru-Scale Engineering Supply Co.)

Tips on Handling Needle Tubing

Needle tubing for any application should be handled with great care from the moment it arrives in the receiving department. It has been produced to meet surgical standards and, therefore, throughout its manufacture it has been closely checked. It has also been meticulously inspected prior to shipment. Before the tubing is packed for shipment it is cleaned and coated with a preservative.

The following pointers should be helpful to production men working with needle tubing:

1. After receiving incoming shipments of tubing, packages should be carefully wrapped or otherwise protected against moisture and fumes. Bear in mind that the most minute particle of dirt, dust or metallic flakes, if allowed to remain on the surface for any length of time, may induce corrosion.

2. When tubing is to be used, only that amount that will meet immediate requirements should be removed. After removing, package should be re-closed.

3. Tubing should be thoroughly cleaned prior to use. Tubing made by Superior is shipped coated with a rust preventative, which can be removed by alkali or solvent degreasing. A variety of suitable alkali cleaners are commercially available, any one of which can do the job. Solvent degreasing agents such as Stoddard Solvent, carbon tetrachloride, trichlorethylene, etc., are generally used because of their efficiency.

4. Bending of tubing of any analysis and size is an important operation which must be performed with care. Certain basic rules define the limitations on minimum bend radius while holding out-of-roundness or collapse and kinking to a minimum. Essentially, these rules are based on ratio of o.d. to wall thickness and type of equipment used, as for example, stationary and revolving dies with or without mandrel. For a given tube size the minimum radius of bend may vary from one times the o.d. to six times the o.d., depending on the type of equipment. Conversely, for a given type of equipment the minimum bend radius will be affected by the ratio of o.d. to wall thickness. For a large o.d., light wall tubing small radii are difficult to obtain, whereas less difficulty is experienced with smaller o.d.-wall ratios.

Although the same basic rules would govern the bending of needle tubing, it is obvious that the type of equipment used would have to be adapted to the small size involved. Generally, however, the ratio of o.d. to wall in needle tubing is very favorable for the production of short radius bends without collapse or severe deformation.

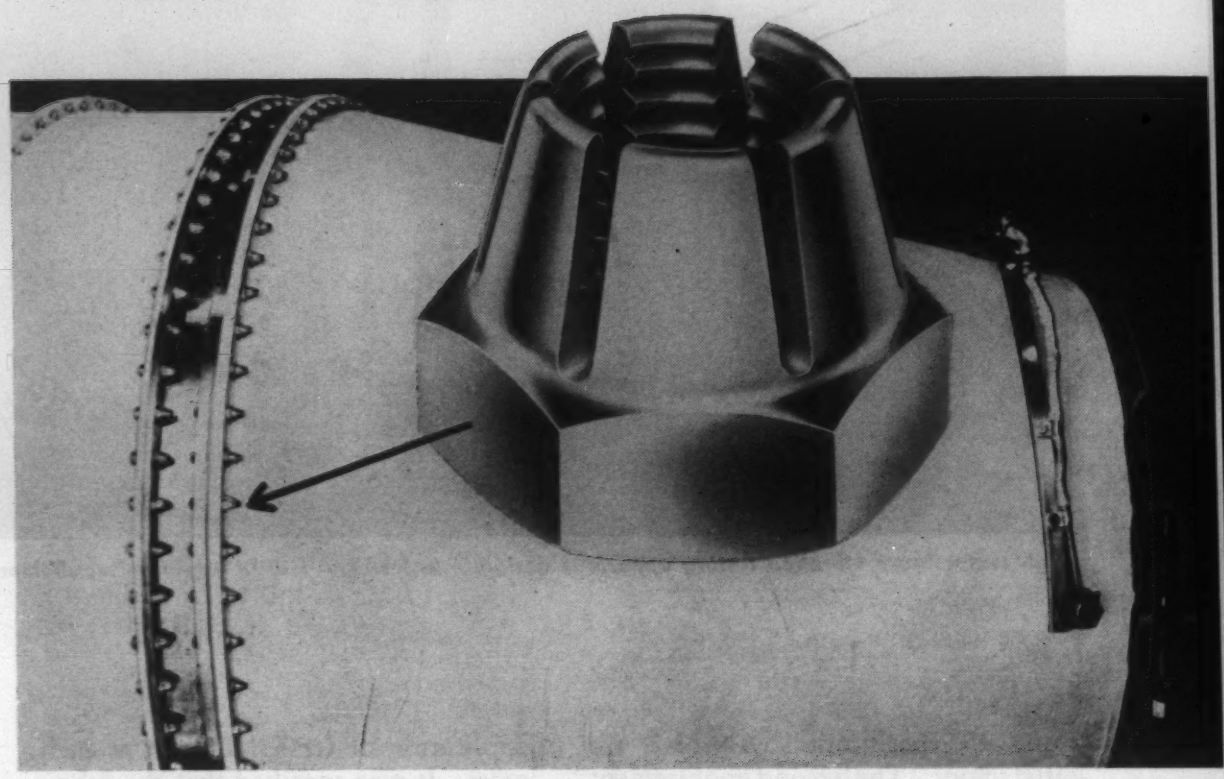
5. As mentioned earlier, needle tubing is commonly joined by soft soldering or silver brazing. Soft soldering involves a few difficulties, but these can generally be avoided by following the standard procedures recommended for soldering the stainless steels. As noted earlier, special silver brazing alloys are manufactured for austenitic stainless steels, and a reliable supplier should be consulted. In general, joining of cold worked austenitic stainless steels is best accomplished through the use of a high flow point silver brazing alloy. For fully annealed material, lower flow point alloys generally are satisfactory.

In conclusion, Type 304 needle tubing is not difficult to use. Provided certain precautions are taken, selection and fabrication should present no serious problems. Needle tubing should prove unusually strong, corrosion resistant and durable. The success with which an increasing number of manufacturers are utilizing needle tubing in severe service applications testifies to its unique properties. In cases in which the precision, cleanliness, durability and corrosion resistance of surgical instruments, plus the finish and strength of stainless steels, are required in a small tubular part, consideration of needle tubing is definitely indicated.

High Temperature Fastening Problem Solved with Special Self-Locking Nuts

by **CHARLES F. FARONI**, Chief Product Engineer, Elastic Stop Nut Corp. of America

Proper materials selection coupled with new design resulted in fasteners that successfully withstand vibration at temperatures to 1200 F.



New basic nut design helps solve strength and seizure problems resulting from the high temperatures encountered in this GETG-190 turbo-jet engine.

• THE INCREASING TREND for power plant operation at higher temperatures has brought with it a host of difficult engineering problems. These have required, for their solution, the cooperation of many specialists in different fields of engineering. Some illustration of this fact is provided by the development of satisfactory self-locking fasteners for service at high temperatures.

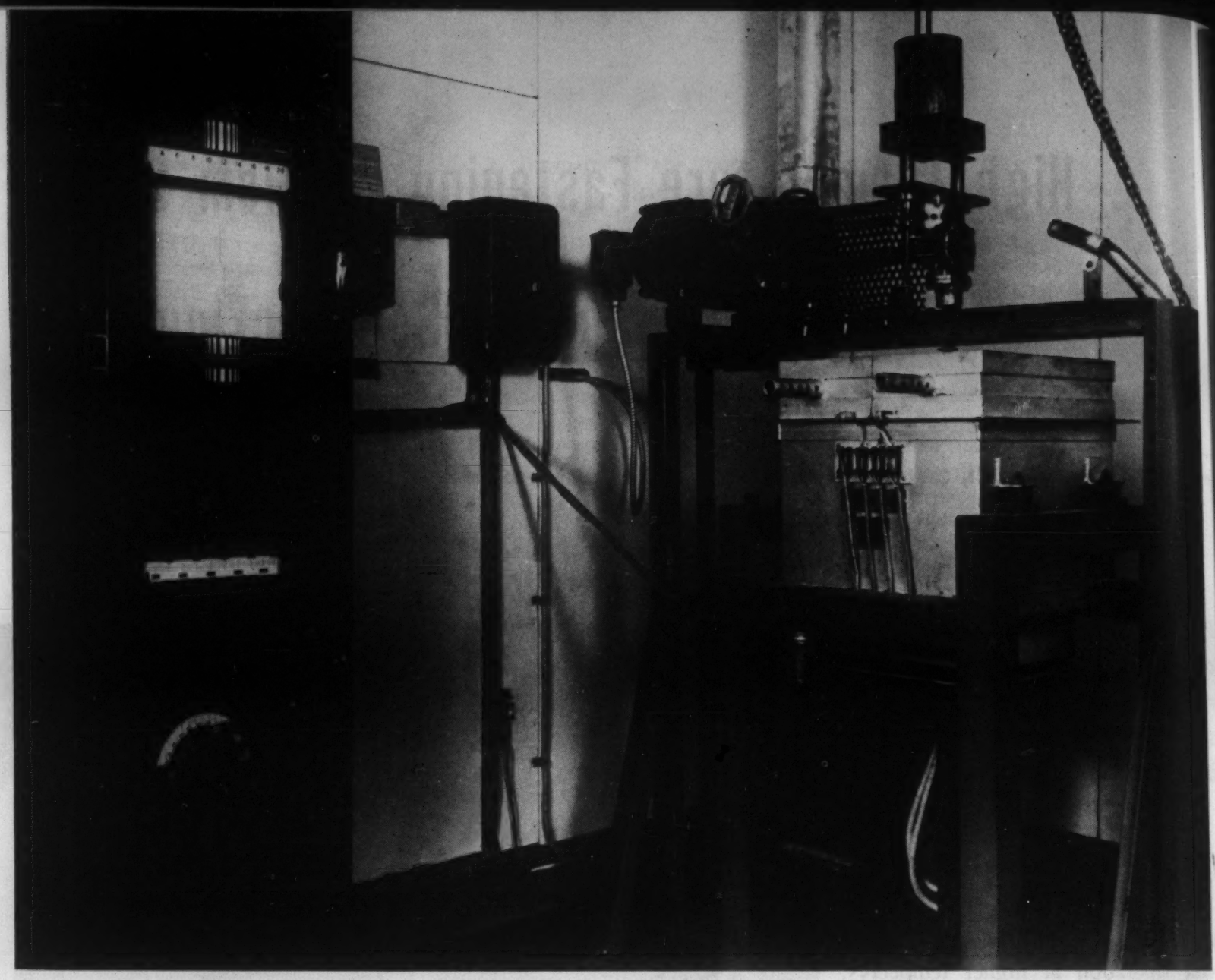
Self-locking fasteners for high temperature service must perform with all the dependability, convenience and security that is expected and attained in self-locking fasteners for the normal range of temperature operation. To meet these requirements, however, it is necessary to develop a suitable self-locking design and one which is adaptable to mass production from materials which will provide the requisite strength and stability at high temperature.

In many otherwise satisfactory materials, structural changes occur after long exposure to temperatures above 1000 F, with marked effects on their corrosion or heat resisting characteristics. Other materials display a tendency to creep excessively or to relax under load. Such an effect seriously reduces the efficiency of the self-locking device.

Following World War II, aircraft power plant designers focused their attention on jet propulsion. Although many parts of a reciprocating engine operate at elevated temperatures, the problems of temperature are aggravated in engines operating on the turbo-jet principle. Most types of lock nuts used on reciprocating engines would either relax and loosen or become virtually welded to the bolt and have to be cut or burned off if subjected to operating temperatures as high at 1200 F. Fastener performance is a primary concern because all engines must be designed and manufactured with ease of disassembly and field maintenance in mind. As a result, one of the collateral projects created by the jet engine program was the development of fasteners which would meet the assembly and operating requirements of the new engines.

In addition to the higher temperature requirements of jet power plants, it was imperative that the new fasteners have a high degree of resistance to loosening by vibration. Many stories are current about the relatively vibrationless sensations of jet flying, and to a degree this is true when contrasted to the torque and pounding of propeller type flying. But engine vibration still exists at higher and more destructive frequency cycles; airplanes must still take off over rough runways and land with smacking impacts; they fly through rough air conditions; they must sustain the shattering recoil of firing machine guns, cannons and rockets.

The Defense Department and engine manufacturers generally agree that temperature requirements can be grouped into three broad categories. For the cold end, temperatures are generally under 250 F and standard self-locking parts manufac-



High temperature vibration testing apparatus designed to test the critical vibration requirements of stop nuts at temperatures up to 2000 F.

tured to specification AN-N-5 are satisfactory. The second requirement covers fasteners which will perform satisfactorily up to 550 F. The third covers the exhaust end of the engine, which requires fasteners that will withstand temperatures of 1200 F or higher.

Many high temperature alloys were evaluated for continuous operation at 1200 F. On the basis of all-around performance, the steel selected for the nut was a chromium nickel, 18: 10 type stabilized with columbium, and modified with selenium to obtain the free-machining qualities necessary for cutting close tolerance internal threads.

All alloys suitable for use at elevated temperatures show a marked tendency to gall and seize when rotated in pressure contact with each other. This tendency to "cold weld" results in scored and mutilated threads that cannot be disassembled without destroying the nut or bolt. To overcome this difficulty, a special lubricant had to be developed that would become an integral part of the nut, and would not require the application of fresh lubricant at each reuse. It was specified that the lubricant must have no harmful effect on the nut or bolt material, and that it retain its effectiveness after long exposures to elevated temperatures.

In point of time, the search for a satisfactory lubricant was almost as prolonged as the hunt for the right material. For example, of the normal plating materials, zinc breaks down at 787 F, and cadmium at 609 F. It was ultimately determined that silver plate, which has a melting point of 1761 F, would be the most suitable lubricant because it provided a smooth soft surface between nut and bolt threads unaffected by atmosphere or temperature, and permitted many installations and removals without damage to the threads. Unlike other possible lubricants, such as copper, lead and mercury, silver had no damaging effects on the nut or bolt material. At the time silver was specified as the finish for the new 1200 F nut, there was no suitable mass production method of bonding that material to type 18:10 stainless steel and a large-scale plating method had to be developed.

The design of the fastener finally chosen for high temperature work is illustrated. The locking element consists of a conical section of six longitudinal segments, each inwardly offset to provide a cantilever beam pressing against the bolt and frictionally locking the nut to the bolt. The proportions of the beam are selected to keep the stresses at a level that will not result in excessive creep or relaxation at temperature. The contact area is large on the other hand to keep contact pressures low and reduce scoring tendency to a minimum. In addition, the long beams provide the elasticity required to develop locking torque at the extremes of bolt thread tolerances.

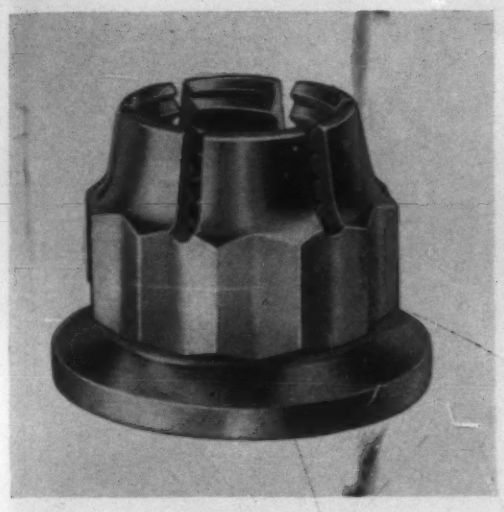
The new nut design was tested with the high temperature vibration apparatus illustrated. The accompanying graphs show the results obtained under vibration, reuse and elevated temperature tests.

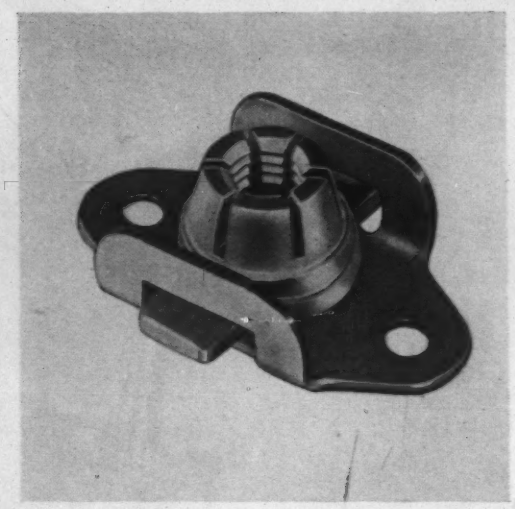
Initial production pieces made in the standard hexagonal nut shape were submitted to several engine manufacturers and to the Navy

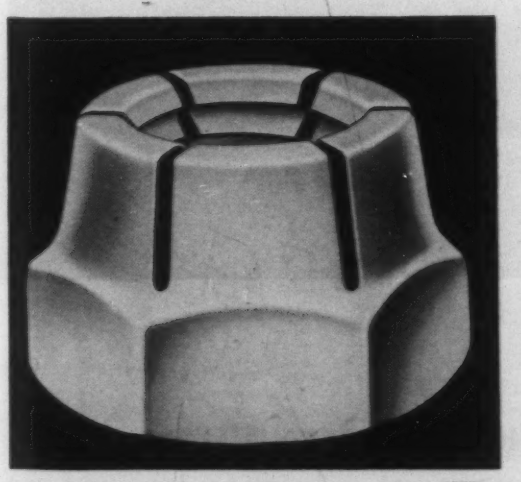
Bureau of Aeronautics for testing. The basic design passed a series of elevated temperature, vibration and model tests, and the fastener was ordered into production. However, in an industry growing and changing so rapidly as the jet engine industry, a basic nut shape is only the starting point. Almost from the moment the first nuts were accepted, consideration was being given to special shapes which would embody the same locking principle, but which would also, by reason of their special conformation, be directly suited to specific space, clearance and location problems encountered in constructing the new engines.

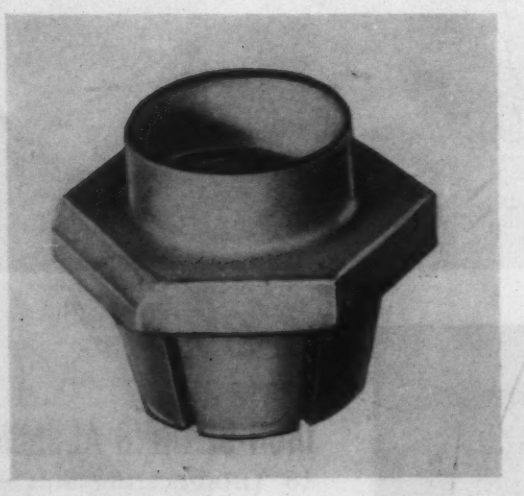
One of the first modifications was a two-lug nut designed to be riveted to the structure. A second type was designed for joining the tail cone sections where high bending moments had to be overcome by the tension on the bolts. To attach small panels and access doors, a strip design was developed in which a series of nuts having a special base was inserted into a stainless steel channel. These channels, when riveted to the structure, provided a series of pre-positioned multiple fasteners which contributed to the ease and speed of assembly. A floating type of anchor nut was designed to be individually riveted to the frame in the desired position. The movement permitted mating sections to be assembled readily even though there was a slight misalignment.

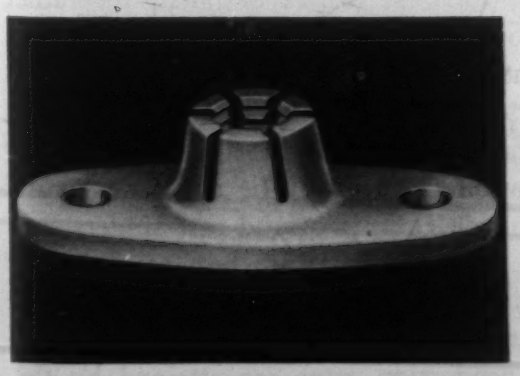
Parts such as these, originally designed to meet a specific requirement, often develop into standard fasteners for an industry. Thus, the parts illustrated will probably become standard for jet engine assembly in the near future. However, the search for new nut compositions and new solutions of fastening problems will continue, for more efficient power units will require fasteners capable of satisfactory performance at temperatures of 2000 F or higher.

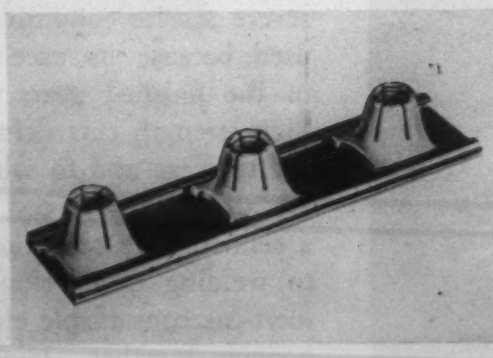




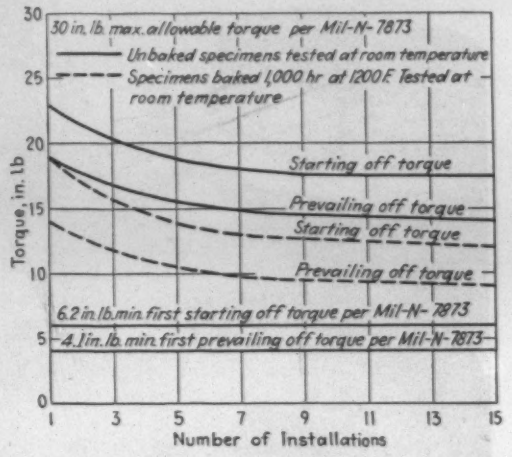




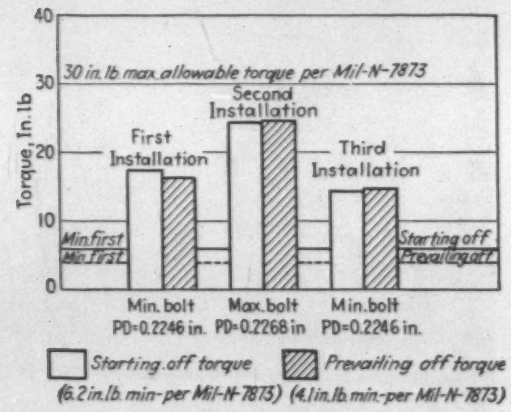




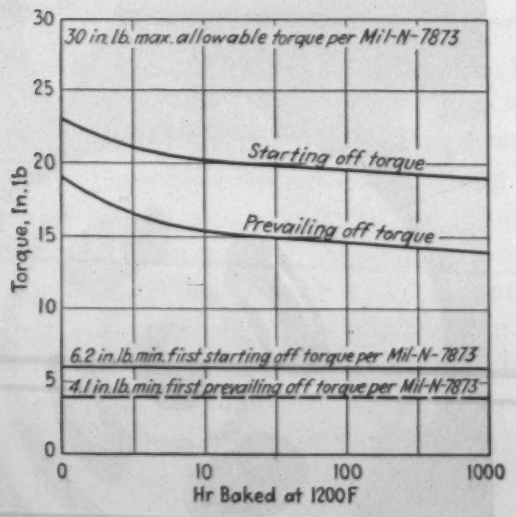
Modifications of the basic nut design to solve various space, location and clearance problems.



Effect of repeated application on the locking torque of the nut.



Locking effectiveness of the new nut at bolt thread tolerance extremes.



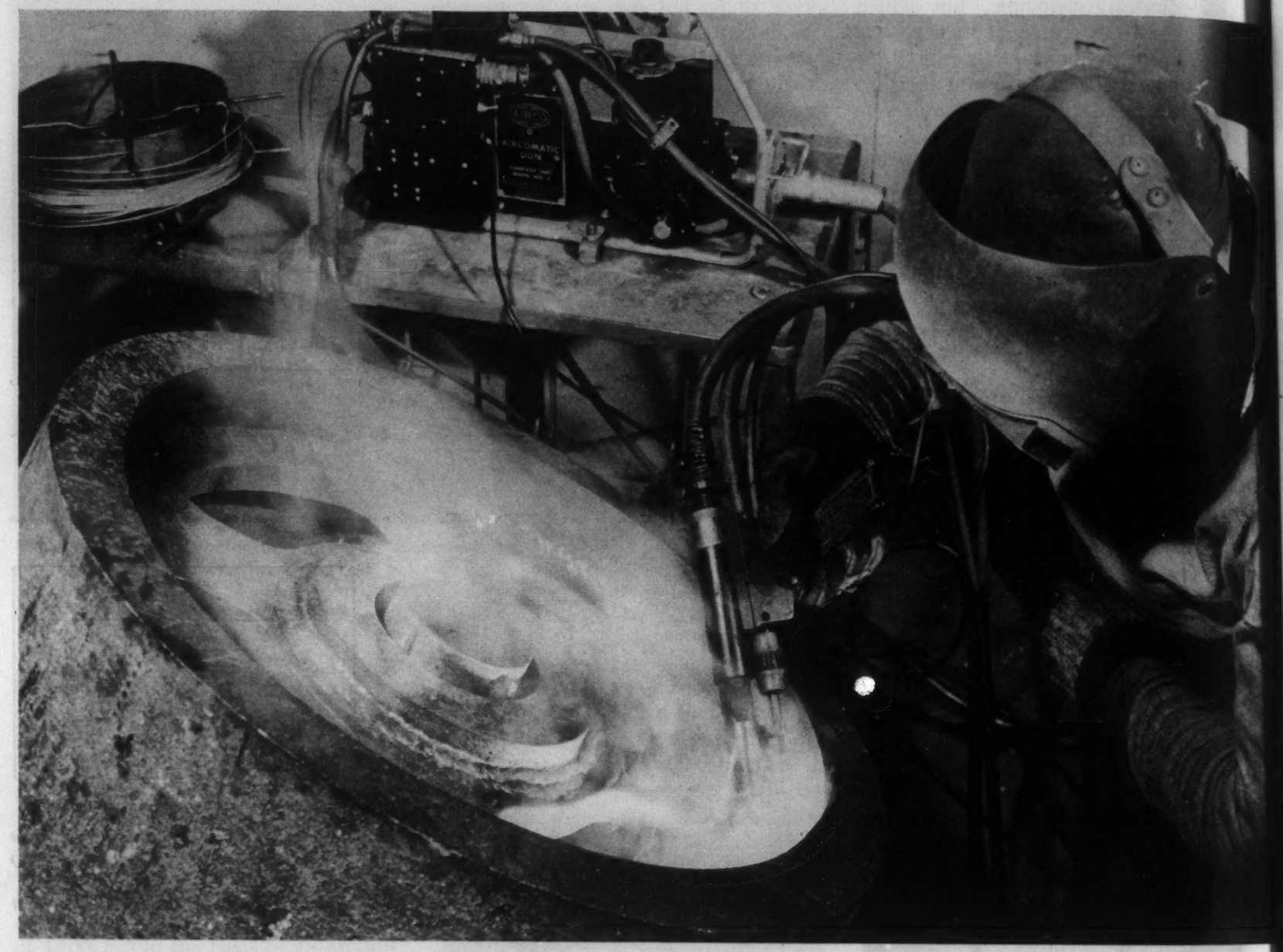
Effect of heat and time on locking torque.

Materials at Work

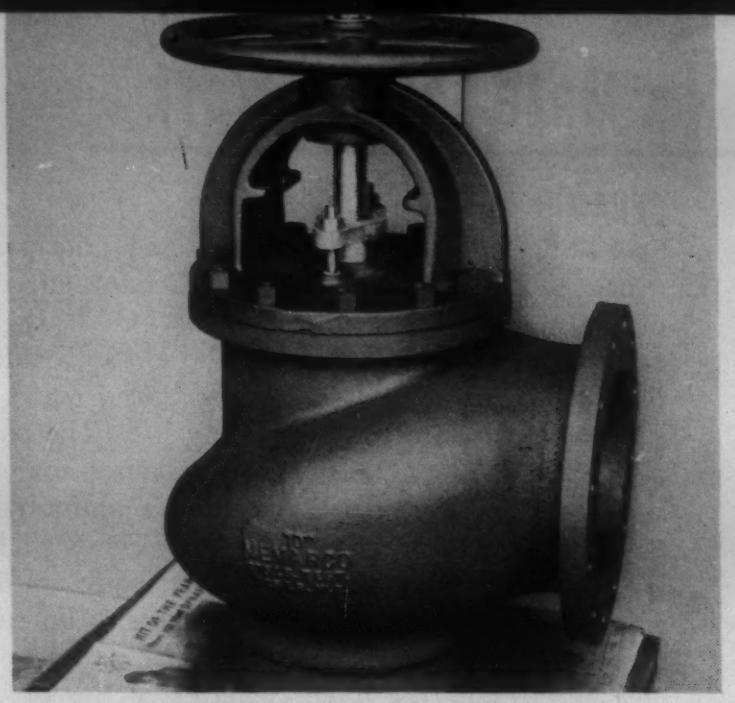
Here is materials engineering in action . . .

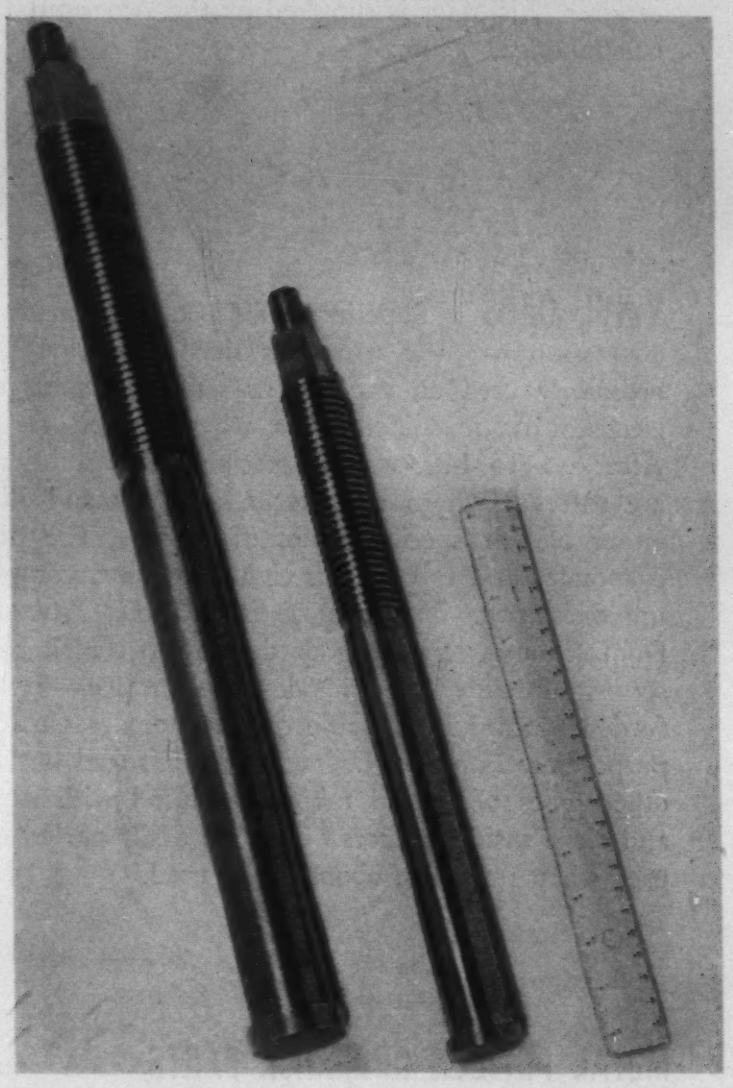
New materials in their intended uses . . .

Older, basic materials in new applications . . .



IRON-BEARING ALUMINUM BRONZE GEAR BLANKS Ampco 18 (iron-bearing aluminum bronze) is being used in sand cast and centrifugal cast form for gear blanks designed for rather severe service conditions in the marine industry. This alloy is used because its excellent bearing qualities minimize failures of the finished gears by pitting and flaking, and because its high strength cuts deformation. The alloy is also highly resistant to wear and to salt water corrosion. The component parts are a centrifugally cast outside ring, two sand cast spiders, and a centrifugally cast inner hub. All parts are heat treated prior to welding to develop maximum mechanical properties. The inert-gas consumable electrode method is used to weld the components together. High production rates are attained by this method.





SILICON ALUMINUM BRONZE VALVE STEMS Failure of main cargo or cargo stripping valves aboard a tanker can prove exceptionally costly either through contamination of a cargo or through maintenance expense, plus loss of time. In an effort to increase the strength and reduce galling in these suction valves, Mechanical Marine Co., Inc. changed from bronze to silicon aluminum bronze for valve stems. The alloy used was Duronze III, supplied by the Bridgeport Brass Co.

When two clean metal surfaces are rubbed together under heavy pressure, galling may take place between the two mating materials. Once this condition starts, it progresses rapidly with each operation. Seizure eventually takes place. Duronze III often reduces wear galling to a low point when mated with other metals. It has a hardness of B85 Rockwell and provides an excellent bearing surface in slow turning gears and screws where heavy loads are involved.

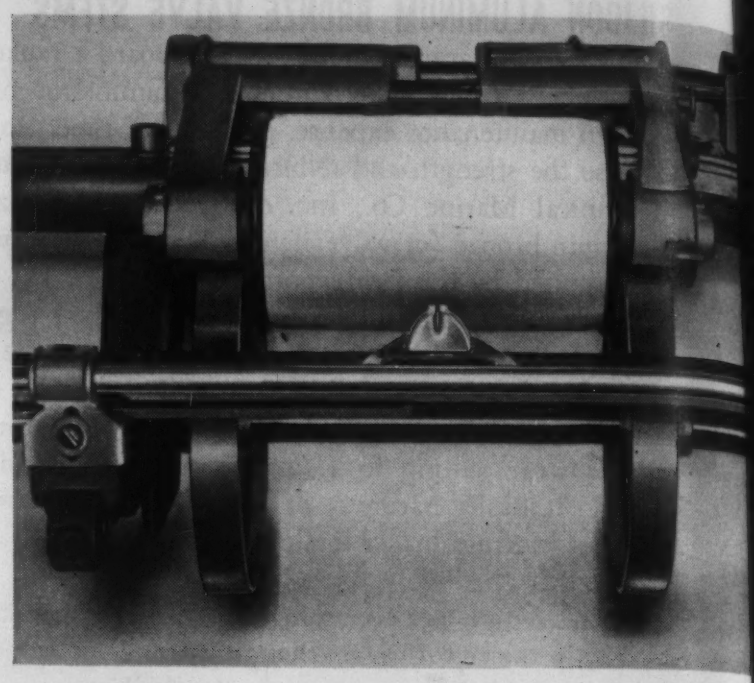
High strength is needed in this type of valve stem as often deposits produced through changing from one cargo to another and the introduction of sea water for ballast can cause them to stick. In such event, lever bars are often used on the valve wheel to open or close them. This increased load may cause ordinary bronze stems to distort or twist off. Duronze III has a tensile strength of 85,000 psi in the annealed state. This is considerably higher than the ordinary cast bronze alloys.

The main cargo valve stem is about 2 ft. long. It is turned for 13 in. from 2-in. rod to 1¾ in. for the modified Acme thread with a five pitch. The threads are milled. A smaller diameter is turned for the wheel nut and a bevelled square is milled to take the wheel. Duronze III is 91 copper, 7 aluminum and 2% silicon.

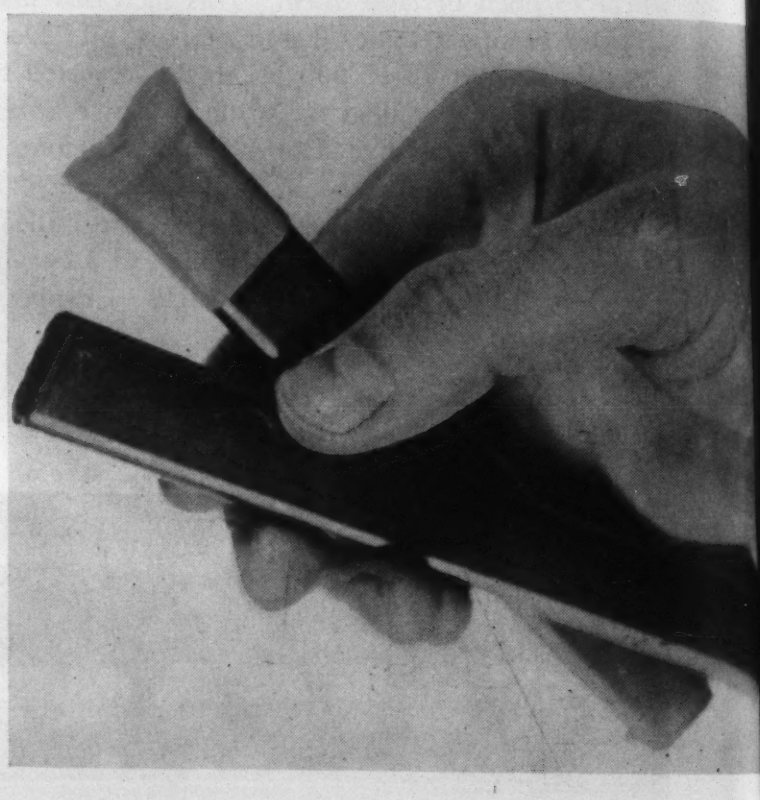
POLYETHYLENE WIPING BLADE Polyethylene sheet has replaced rubber as material for the wiping blade of a device used by Pond's Extract Co., Clinton, Conn., to wipe off the excess and smooth face cream in jars after they have been filled on high-speed packaging lines. Pond's adopted the plastic material when cloth-inserted rubber sheets, selected originally for their flexibility, were softened and eroded by continual contact with face cream. Frequent replacement and servicing were also necessary to keep the old type wiper in working condition. Polyethylene, while furnishing the required flexibility, is also unaffected by alcohols, perfume oils or hydrocarbons. Another asset of the material lies in its low rate of water absorption. The material has been placed in operation in the cream leveling-off device of a filling machine furnished by the Feller Machine Co., which is capable of filling 120 jars or more per min. with face creams. Polyethylene sheet for the blades is supplied by Plax Corp.

Materials at Work

CERAMIC THREAD GUIDES The U. S. Acme High Speed Spooler is a textile machine used principally on fine denier synthetic yarns. One of the most important parts of the machine is the thread guide. Ordinary guides are rapidly cut by synthetic yarns. The U. S. Textile Machine Co. adopted this ceramic transverse thread guide after comparative tests which proved its long life. The polished slot of this guide is 1/32 in. wide. It assures accurate control at the end of the transverse, creates a uniform wind, and gives a package of uniform weight. These guides are accurate and are physically and dimensionally uniform. They are smooth, hard, homogeneous. There is no surface skin to wear through. Wear is very gradual, and simply exposes new surfaces of the same character as the original. The ceramic, AlsiMag, is supplied by the American Lava Corp., Chattanooga, Tenn.

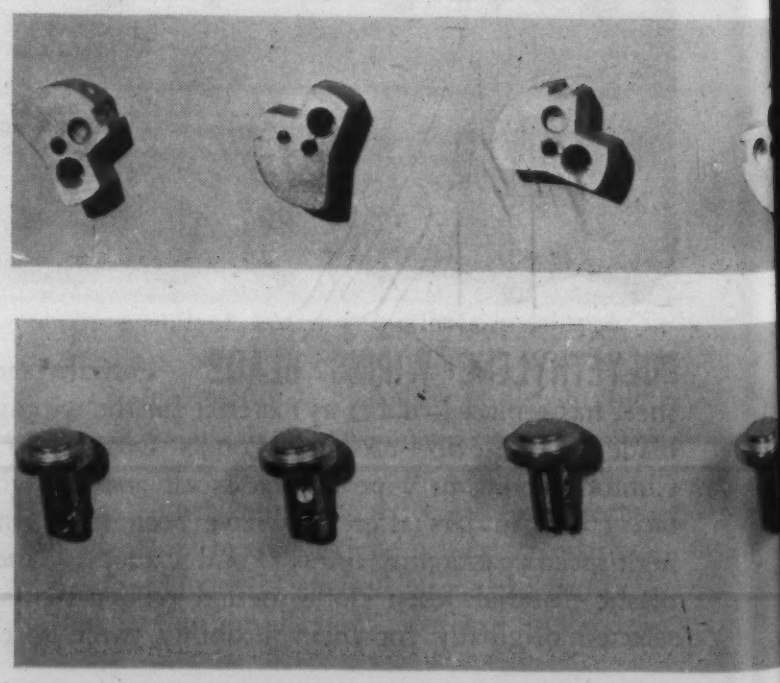


VINYL CAPS Superior Tube Co. has made a special adaptation to their particular needs of vinyl plastic caps ordinarily used on exposed or vunerable parts of delicate electrical or machined parts when packed for shipment. After a 1- to 4-hr. soak in special dilator solution, the caps are soft enough to be stretched slightly and slipped over either end of special grades of tubing. The dilator soon evaporates and cap shrinks tightly to tube, completely sealing open end. The purpose is to protect vulnerable ends from scuffing, scratching or denting in transit, and to preserve absolutely clean inside tube surface. Protection afforded by caps is desirable on some analyses used for such purposes as Bourdon, hydraulic, aircraft fuel line, and many other types of special tubing produced with super-smooth and clean inside surfaces. Caps are easily peeled off by tube user when tubes are about to be used.



METAL POWDER ORDNANCE PARTS A number of parts made for the Army have been switched to powder metal production, with consequent cost, design and fabrication advantages. The M21A4 booster rotor blanks for artillery ammunition fuzes (above) are made by various fabricators. New Jersey Zinc Co. brass powder (78.5 copper, 20 zinc, 1.5% lead, nominal) is used. The powder is pressed and sintered before the parts are drilled and counterbored. The rotor blanks were formerly machined from brass bar stock. Powder metal techniques gave a high production rate (1000 per hr. per set of tools) and a reduction in the number of secondary operations required.

The International Powder Metallurgy Co. makes the slider for the MK-501 ammunition fuze (below) from brass powder. These parts were formerly machined from rod. The powder metal technique saves 25% in scrap loss and gives more uniform weight and size. This uniformity is important in fuze arming parts. The tooling is also quicker and production costs are lower.



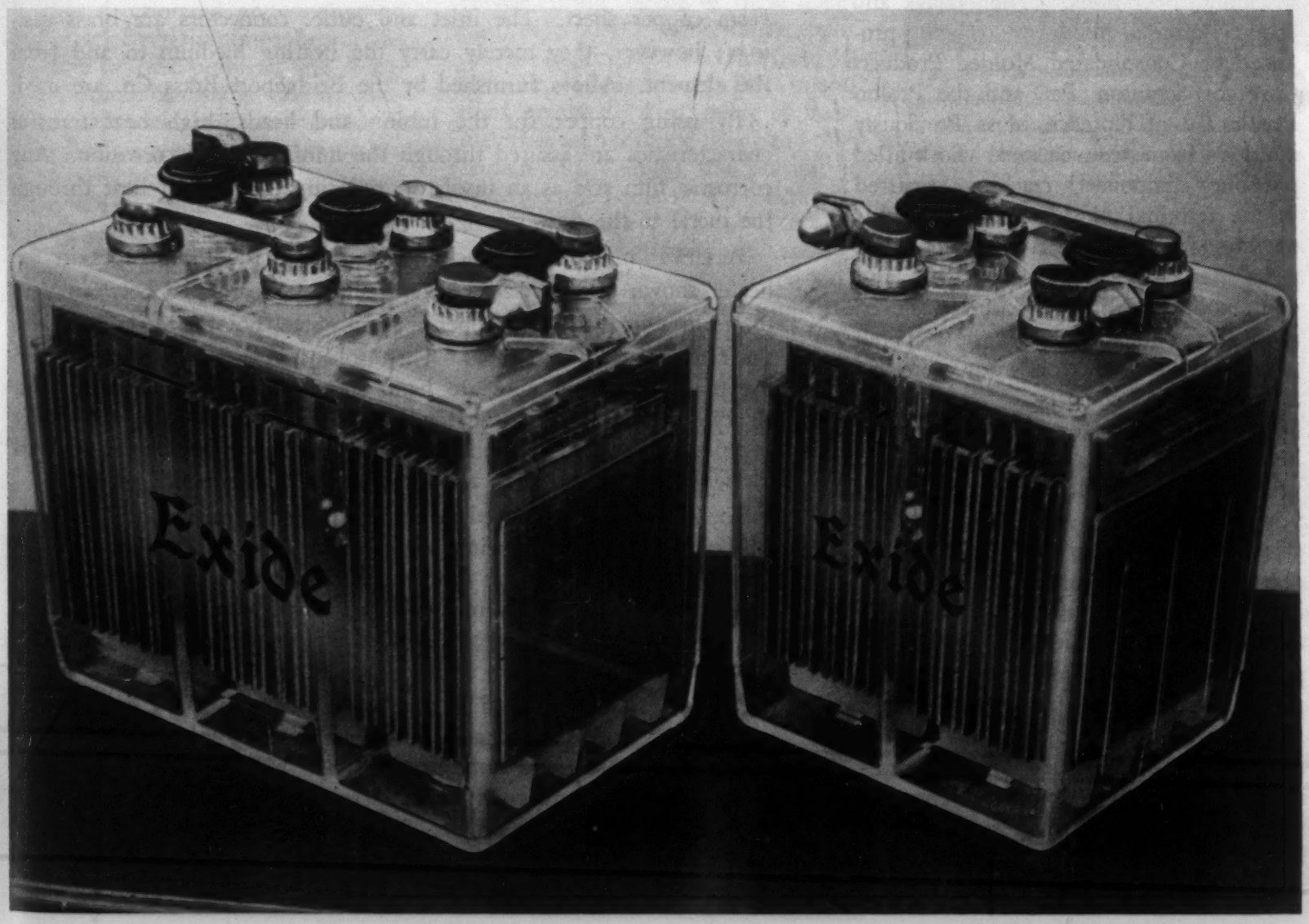
MATERIALS IN STORAGE BATTERIES Several improvements in the Exide-Ironclad Storage Battery are designed to prolong battery life in heavy duty service. Corrosion of the positive-plate grid is one of the leading causes of battery failure. Introduction of a new alloy, Silvium, in the construction of the positive-plate grid of the Improved Exide-Ironclad battery, reduces the corrosion factor and assures a longer positive grid life. Silvium is an alloy of silver, lead and other components.

Another cause of curtailed battery life is the loss of the active material from the positive plate. When it becomes sediment in the bottom of the cell it represents lost capacity and reduction in battery life. There also is the threat of possible trouble from short circuits within the battery caused by an accumulation of loose active material. In the new battery, the grid is made up of metal core rods which are inserted in slotted hard rubber tubes. Active material is then packed into the tubes surrounding the rods. The slots in the tube permit free access of the electrolyte to the active material, but they are fine enough to prevent it from washing out.

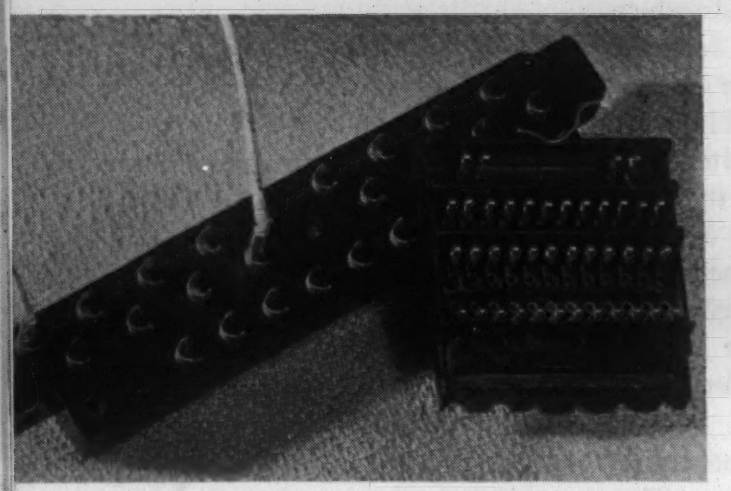
The bottoms of the tubes were formerly sealed with an alloy bar. After considerable service life, however, corrosive action on this metal bar closing the tube bottoms would eventually breach the seal. Active material would then seep out and be deposited in the bottom of the container. After extensive research, a better replacement was found for the metal bar. Molded in a single bar of polyethylene, a plug for each tube projects to effectively and permanently seal it at the bottom against loss of active material. The new tube sealer is unaffected by the electrolyte or electrolytic action, thus holding its shape and remaining intact.

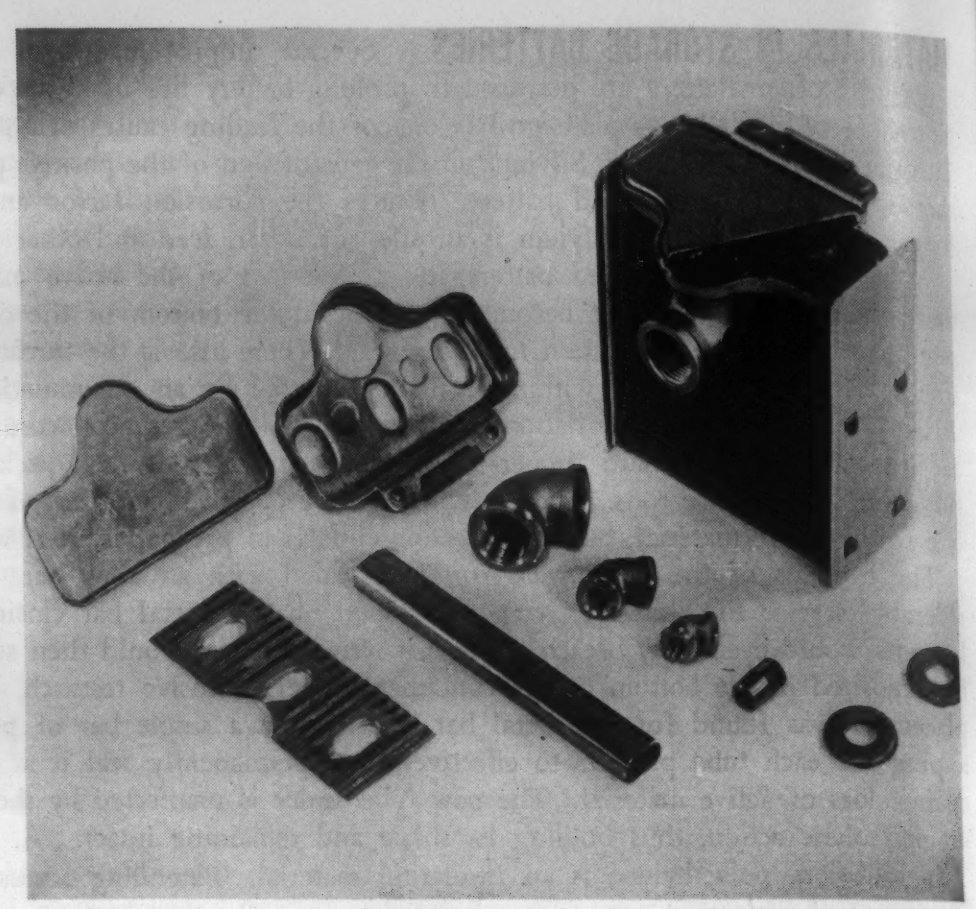
In addition, polyethylene is an insulating material. Extending across the entire bottom of the plate, it acts as a safeguard against shorting between plates. The elimination of metal at the bottom of the positive plates assures better negative plate performance because of low local action and the reduction or elimination of shedding of active material.

The other improvements in the Exide-Ironclad battery are a new homogeneous sealing compound; a seamless shock proof jar; unbreakable plastic vent plugs, and a corrosion and impact resistant plastic steel tray coating.



Materials at Work





RUBBER-PHENOLIC TERMINAL BLOCKS

Terminal blocks for International Business Machines are now being molded from G-E woodflour filled rubber-phenolic plastics to reduce breakage during assembly operations. The relay and counter terminal moldings are being produced by Consolidated Molded Products Corp. of Scranton, Pa., and the Prolon Plastics Co. of Florence, Mass. Previously molded from conventional flock-filled phenolic compound, cracking occurred in the terminal blocks during assembly operations when metal contacts were press-fitted into the molded part and crimped into position. Cracking was even more predominant when the tapered plugs on the connector wires were inserted into the contacts.

Since the design on these parts could not be changed, a stronger material, which could be molded in existing molds, was required. The rubber-phenolic met this requirement and combined the necessary resiliency and strength to hold breakage to a minimum. In addition to the elimination of breakage during the press fitting of metal inserts, G-E rubber-phenolic plastics can be molded around large inserts to reduce cracking, which frequently occurs on cooling with ordinary thermosetting compounds. The possible failure of insert applications due to shock, vibration and thermal changes is also reduced.

COPPER CONVECTION HEATERS

The ability to conduct heat at a rapid rate and to withstand corrosive attack has made copper an integral part of convection-type heating systems. The unit, manufactured by Tuttle & Bailey Inc., has oval copper tubing. The two heads which form the inlet and outlet ends of the radiator are fabricated from copper sheet. The inlet and outlet connectors are brass castings; however, they merely carry the heating medium to and from the element. Alloys furnished by the Bridgeport Brass Co. are used.

By using copper for the tubing and heads, high heat transfer characteristics are assured through the minimizing of corrosion. Any corrosive film acts as an insulator, reducing the flow of heat through the metal to the fins.

A clever method of attaching the fins to the three tubes in the heater shown was devised. The fin sheets are dropped between steel plates in a jig with the proper spacing. Steel points are inserted into the front ends of the tubes. Then solder wire is put into holes in the points and the tubes are hand started into the first plate. An air cylinder then forces the tubes through the plates and the solder is pulled through by the tubes. A space for the solder wire is allowed for when the holes in the fins are pierced and formed.

The solder is then melted by a special method of electrical heating. While the next one is being soldered, the operator washes the flux from the previous unit by dipping. Not only is greater rigidity obtained by soldering, but a metal-to-metal bond between fins and tubes is assured. The fins are strengthened by corrugation which also increases surface area.

The heads are fabricated in two pieces. One part is a drawn shell and has the holes pierced and drifted to take the tubes and the connector. A second part is the end plate, which fits into the drawn shell. The high ductility of the copper makes the drawing and forming operations relatively simple. Phosphor copper brazing rod is used to join the connectors and tubes to the head as well as sealing the end plate.

New Potting Compound Has Controlled Shrinkage

—A NEW MATERIALS PREVIEW

● POLYFORM IS THE name given to a series of polyester type compouds especially formulated for potting, encapsulating, sealing, embedding, and impregnating electrical and electronic components—to insulate such units against shock, heat, vibration, moisture and corrosion. The outstanding characteristic claimed for the new material is its ability to polymerize to a tough, infusible and insoluble solid at room or elevated temperature, without danger of fracture or uncontrolled shrinkage. The new compounds are available in experimental and pilot plant quantities from B. G. Forman Co., New York, N. Y.

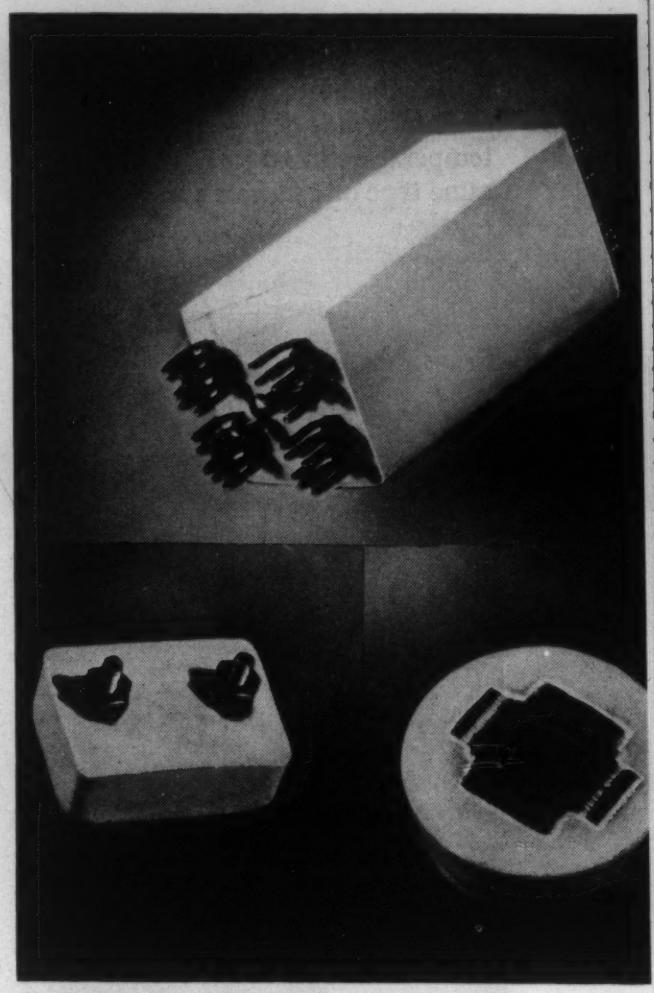
Embedding or potting of electrical and electronic components was started during the last war. Under battle conditions, delicate electronic equipment could not be repaired in the field. In addition, such components quickly deteriorated under vibration and attack by moist atmospheres The solution to these problems was recognized simultaneously in various quarters; each electronic unit could be completely embedded in a plastic material which would afford it protection. When a unit or assembly went out of order, it could be discarded and an identical unit put in its place.

The theory was fine, but recent practice has revealed many difficulties, principally in the actual production of potted units. Most of the presently used casting resins exhibit uncontrolled shrinkage to such an extent that encapsulated components are often damaged or pushed out of place, and the plastic itself often cracks during setting. This results in a high rejection rate of produced units. A rejection rate of 66% has been reported by one company.

To overcome the disadvantages of uncontrolled shrinkage, various schemes have been tried. One method was to coat the components with an elastomeric material prior to encapsulation. This was quite expensive. Another way out is to mix a large percentage (up to 65%) of elastomeric resin directly into the potting compound itself, giving the finished casting a rubbery, thermoplastic quality. This may be unsatisfactory where dimensional stability, rigidity and precise tolerances are required.

Another common disadvantage of potting materials is their slow and involved curing. Some of these materials, especially in transformer applications, require an oven bake from 12 to 36 hr, with as many as three operations involved. Also, many of these materials are inhibited by air and thus remain tacky unless the potting is done in closed cans, which makes production difficult.

Moisture absorption is another bugaboo. If the encapsulated unit absorbs moisture, electrical properties are immediately affected. Dimensional stability is also affected.



Typical units encapsulated with the new compound. The material can be supplied to either expand or contract on setting, without damaging or deranging the parts enclosed.

Some of the presently used materials are also prohibitively costly. One formulation developed by the National Bureau of Standards is presently quoted as about $27 per lb, and is available in very limited quantities. Cost, however, must not only be considered in relation to the initial expense for the material itself. The final cost—after a production quantity has been successfully encapsulated—is the telling factor. Very often, the cost of an involved and lengthy production cycle, combined with a high rejection rate, will make the initial price of the material dwindle into insignificance.

Advantages and Properties

One of the main claims for Polyform is its controlled shrinkage. According to the formula supplied, the user is said to have a selection of: a small (less than 2%) controlled shrinkage; no shrinkage; or a small

General Characteristics of Polyform

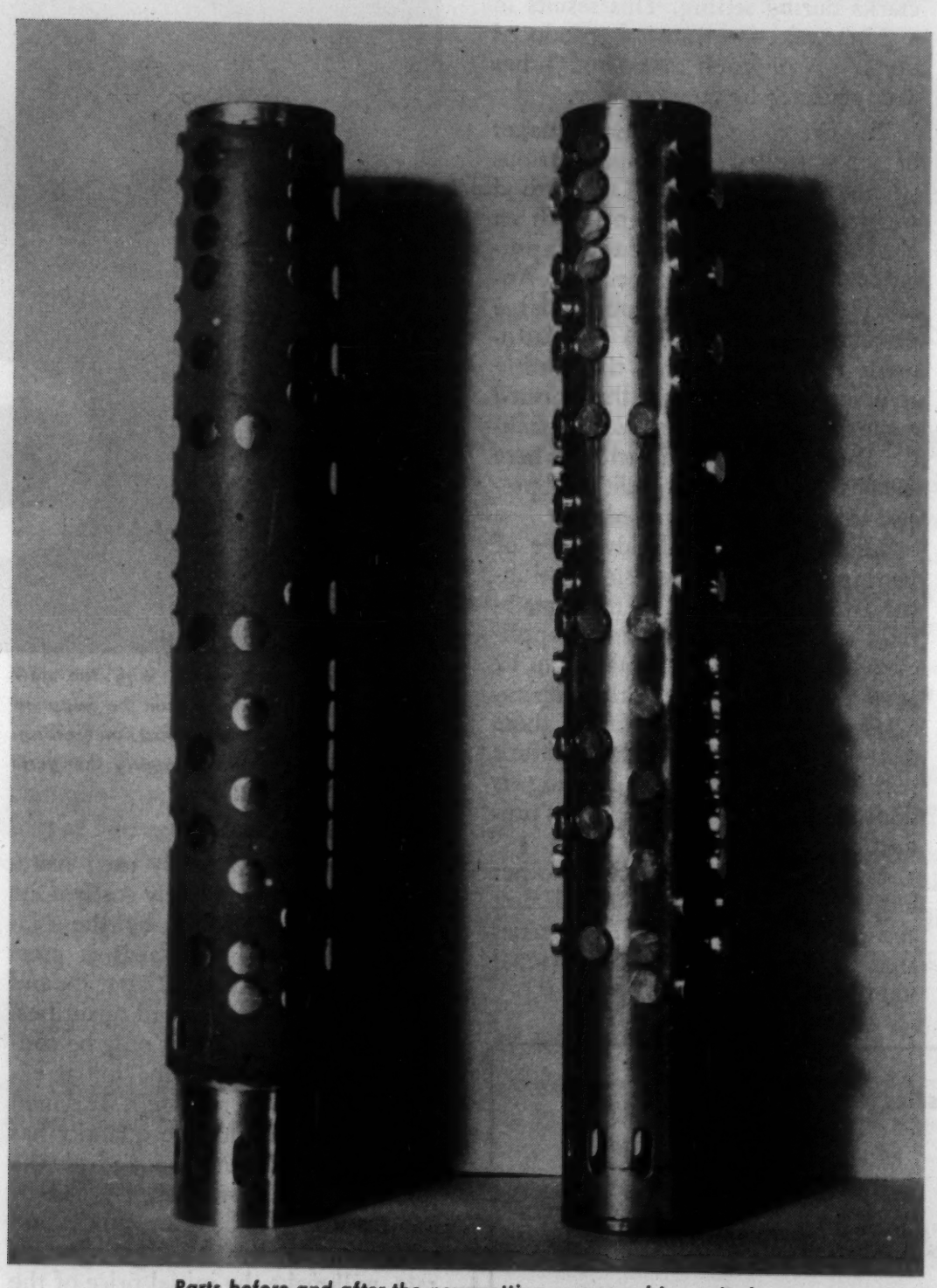
1. Thermosetting.
2. Rigid.
3. Rapid curing.
4. Controlled shrinkage or expansion.
5. Not inhibited by air (exposed surfaces cure tack-free).
6. Low or contact pressure.
7. Choice of room or elevated temperature cure.
8. No volatile by-products.
9. Excellent chemical resistance.
10. Excellent electrical properties.
11. Good resistance to aging.
12. Dimensional stability in a wide range of atmospheres.
13. Good adhesion to metallic and ceramic components.
14. Water absorption practically nil.
15. Excellent heat resistance up to 250 F (continuous exposure); special formulation being evaluated for operation above this temperature.

controlled expansion. The important point in shrinkage is that it should not be so violent as to damage encapsulated components, or push them out of their relative positions. Polyform exhibits what is described as a type of internal resilience. When external dimensions change slightly during polymerization, there is no effect on the embedded components, according to the manufacturer.

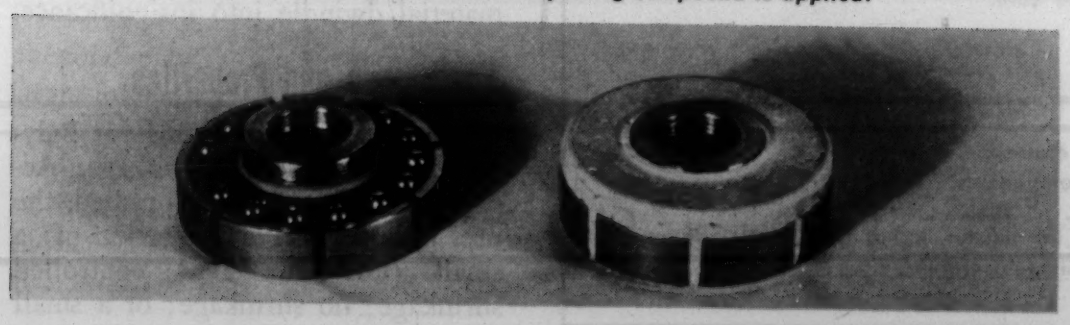
Polyform is designed to set at room temperature in 10 to 15 min, with the same type of catalysts and accelerators used for polyester resins. If faster setting is required, the catalyst and accelerator may be increased. No matter how complicated the part to be potted, encapsulation and/or impregnation can be completed in one operation. Pot life of the compound before addition of the accelerator is several days at room temperature.

In general, the mechanical and electrical properties of the new material are similar to those of polyesters. Impact strength of Polyform castings at normal, low and high temperatures is superior to most of the other currently used potting compounds; its impact strength at high temperatures is superior to materials containing elastomeric resins; its impact strength at normal and low temperatures is superior to the potting materials consisting mainly of polyester resins.

Polyform has high resistance to thermal shock. Alternate cycles of dry ice and boiling water have no effect. Moisture absorption of Polyform castings is practically nil. In addition to dimensional stability, this gives good electrical properties, including high dielectric strength, low dielectric constant, low power factor and high insulation resistance. Most important, these electrical properties remain constant over the life of the equipment. Polyform is not inhibited by air, and all production work can be done in the open atmosphere.



Parts before and after the new potting compound is applied.



Forms and Applications

Applications for Polyform fall into two general categories: (1) a casting material for encapsulating complete electronic units or components; and (2) a material for impregnating and/or encapsulating transformers and similar units, where deeply recessed portions of the equipment must be protected. Transformers are particularly interesting applications. Impregnating and encapsulating with Polyform will give a hermetically sealed unit. The same basic formulation is used—only viscosity need be adjusted—for complete impregnation. Preliminary tests made by one of the large transformer manufacturers indicate that properties of Polyform when used in a transformer and tested according to MIL-T-27 quality approval procedure, are superior to those of any of the other commercially available potting materials they have tested. The results show high insulation resistance, excellent moisture resistance and excellent resistance to temperature extremes, as well as other properties covered in the MIL-T-27 specification. When special properties are needed, such as exceptionally high impact strength over a wide temperature range, organic and inorganic fillers can be incorporated in the Polyform compound.

Polyform is compatible with cellulose esters—acetate, nitrate and propionate — and partially compatible with polyvinyl acetate and ethyl cellulose. It is also compatible with glycerylphthalate alkyds (acetone-soluble types), but incompatible with urea and phenol-formaldehyde resins.

Electroplated Coatings on the Light Metals

MATERIALS & METHODS MANUAL No. 83

This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and applications.

JUNE 1952

by Philip O'Keefe, Associate Editor, Materials & Methods

The light metals—aluminum, magnesium and titanium—are finding many applications in which it is desirable to have an electroplated coating for one or more reasons including (1) decorative purposes, (2) to increase their wear resistance, (3) to give better electrical conductivity or lower contact resistance, or (4) to facilitate joining. A number of commercial plating procedures are now available for aluminum and magnesium. To give the materials engineer a thorough knowledge of the present and future possibilities of plated light metal parts, this Manual covers:

- *Surface Preparation for Plating*
- *Plating Processes*
- *Properties of the Electrodeposits*
- *Applications of Plated Aluminum and Magnesium*

For many years, the problems of plating on the light metals—aluminum and magnesium—were largely of academic interest. Processes were developed, but there were few commercial applications. The situation is now changing rapidly. More and more aluminum and magnesium parts are being electroplated. An even more impressive number of production items are being planned for light metal fabrication and electroplated finish. Practically all metals commonly used for plating can now be used. Plated aluminum and magnesium are climbing to a place near plated iron, steel and zinc in the industrial materials market.

During the development period, electrodeposition on aluminum and magnesium had to contend with two stumbling blocks. One problem was the adherent oxide and/or hydroxide coatings which form on these metals in air or water and tend to prevent a good bond between the basis metal and the plated coating. The second trouble was the activity of the metals themselves. Both aluminum and magnesium are attacked by many plating solutions. They also tend to replace less active metals from some plating solutions, and become covered with non-adherent immersion coatings. All of the proposed plating techniques attempted to solve these problems in one way or another.

Before 1941, the properties and prices of the light metals in accepted applications also tended to discourage the development of commercial plating. Light weight and workability were the selling points of aluminum and magnesium. Their corrosion resistance in the natural oxide-coated state was adequate for many uses, and chemical or electrochemical conversion coatings were available for more corrosive service. For decorative electroplated parts, zinc die castings, steel and iron were cheaper than either of the lighter metals. Although it would have been desirable to have had a good commercial plating process for a few special applications, there was not enough demand to justify intensive development work.

After World War II, the situation changed. Large-scale commercial applications for good plating processes were within sight. This encouraged research in plating. Within the last two years, the potential market has increased even more. It became economically feasible to consider aluminum and magnesium for many parts formerly made of cast iron, steel, copper or die cast zinc. As practical plating methods became available, the light weight, easy forming and favorable buffing quantities of the light metals could be capitalized on in these parts.

At present, there are a number of commercial applications. Rarely are electroplated coatings used primarily for corrosion protection. Other treatments still give better and/or cheaper protection. Parts are usually plated for decorative purposes, although there are other applications. Aluminum cylinders and pistons are porous chromium-plated for wear resistance. Tin plates on aluminum provide friction qualities in bearings. Silver plates on aluminum and magnesium increase electrical conductivity, while copper, nickel, cadmium, tin and silver coatings are used where aluminum and magnesium parts must be soldered. While some of the recent applications have been dodges to beat materials shortages, most of the items being plated are on a sound economic basis and will be continued in the future.

The problems of plating titanium are similiar to those met with the other two light metals. The metal is quite active, and is covered by an adherent oxide coating. While no applications have been announced, research is being done on plating methods for titanium. Plated titanium is not yet commercial, however, although developments can be expected in the near future.

To use plated light metal parts in the right places, the engineer should have a general idea of the plating processes. A survey of the present and projected applications of plated aluminum and magnesium is also helpful to the engineer studying new uses. In this Manual, both these fields will be covered with information of interest and help to the people confronted with materials selection problems.

Electroplating Aluminum and its Alloys

A practical electroplating process for aluminum must meet several requirements. Unless the natural oxide film is removed, it prevents good adhesion between the electrodeposited coating and the basis metal. A second difficulty has been in finding preplating procedures that will work with all types and tempers of aluminum alloys. Alloying elements may be present in solid solution, in microparticles or in intermetallic compounds. These may have different chemical and electrochemical reactivities. For successful plating, the oxide film must be removed or modified, and certain microconstituents which may react in the plating operation must be removed from the surface of the metal.

A number of processes have been developed in the past 25 years. Each process has a number of variations. The success of plating depends directly on the effectiveness of the preplating treatments. For this reason, a discussion of the production processes is largely a resume of preplating treatments.

The Work Process

The first real commercial process for plating aluminum was announced by Harold Work of the Mellon Institute in 1928. Work decided that electroplating on smooth aluminum was impractical, unless the plated surfaces were heat treated to alloy the basis aluminum and the plate metal. He was able to obtain adherent coatings on etch-roughened aluminum, however, without heat treatment. The etching solutions used varied with the alloy. Some alloys were treated in dips high in metal which left an immersion coating of nickel on the roughened surface. Other alloys were treated in baths of low metal content, which gave a less pronounced etch and left coats of nickel, iron or manganese. Nitric and hydrochloric mixture dips were also used to roughen alloys with a pronounced eutectic structure. The etched surface was plated in each case, usually with nickel. Standard nickel baths could be used.

Aluminum kitchen equipment is easy to form and has the advantage of light weight in service. A bright plate gives the equipment the required eye appeal and makes it easy to clean. (Aluminum Co. of America)

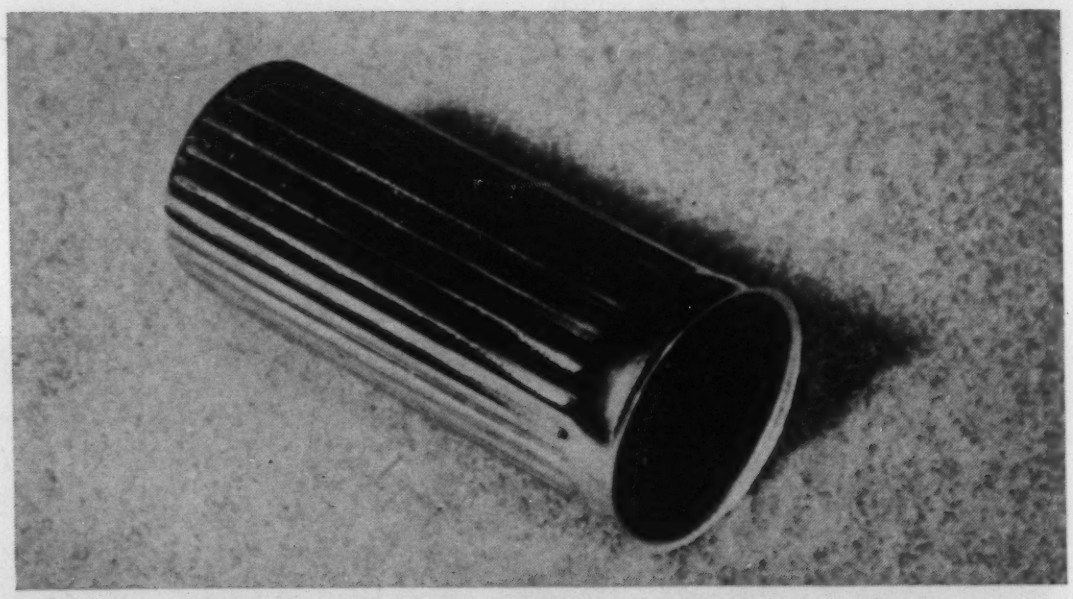
Work's method, essentially, held the plate to the aluminum by mechanical keying. Adhesion of the coating was thereby increased, and hence the corrosion resistance. While some plating was done on a commercial basis, the process itself proved hard to control in production. The results were not sure and the plates obtained were rough by today's standards. Difficulties might have been ironed out had there been a large market for plated aluminum parts. Until World War II, however, the price of aluminum kept it out of the automotive die casting field and other places where plating is necessary. Thus, the Work process never attained real commercial stature in this country. Similar methods of etching the aluminum surface by mixed acids or alkalis to produce a keying effect for mechanical bonding of the plated coating are used regularly in some foreign operations, however.

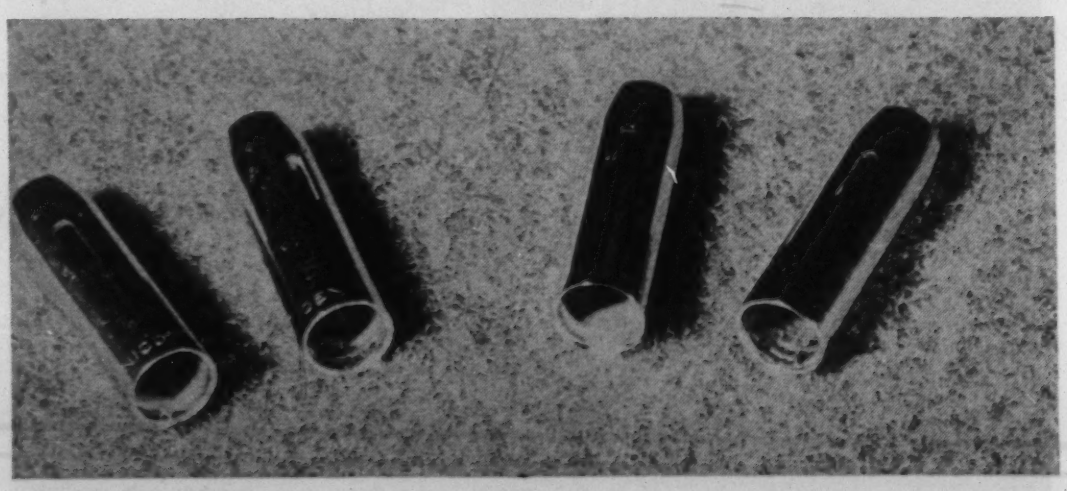
Phosphoric Acid Anodic Process

While the oxide coating on aluminum is generally considered a difficulty in plating, a process has been developed to modify the oxide and make it the base for electroplating. The natural oxide is changed by giving the aluminum an anodic treatment in phosphoric acid. The anodic coating is strongly adherent and is quite porous, but can function satisfactorily as a basis.

Aluminum is first cleaned and degreased, then etched with a caustic solution, dipped in nitric acid and finally given the anodic treatment. When the anodic coating has been applied, the aluminum is plated by practically the same methods as are used in plating other metals. The metal coating is dark at the start of the plating process, indicating that it first consists of fine fibers extending through some of the pores of the oxide coating. As metal deposition progresses, the dark color is replaced by the characteristic color of the deposited metal. Nickel, copper, cadmium, silver and iron have been applied directly over the oxide coating. An undercoat of copper is required for the deposition of brass and other metals plated from highly alkaline solutions.

Coatings deposited by the phosphoric acid anodic method seem to have good adherence and corrosion resistance. There are several disad-

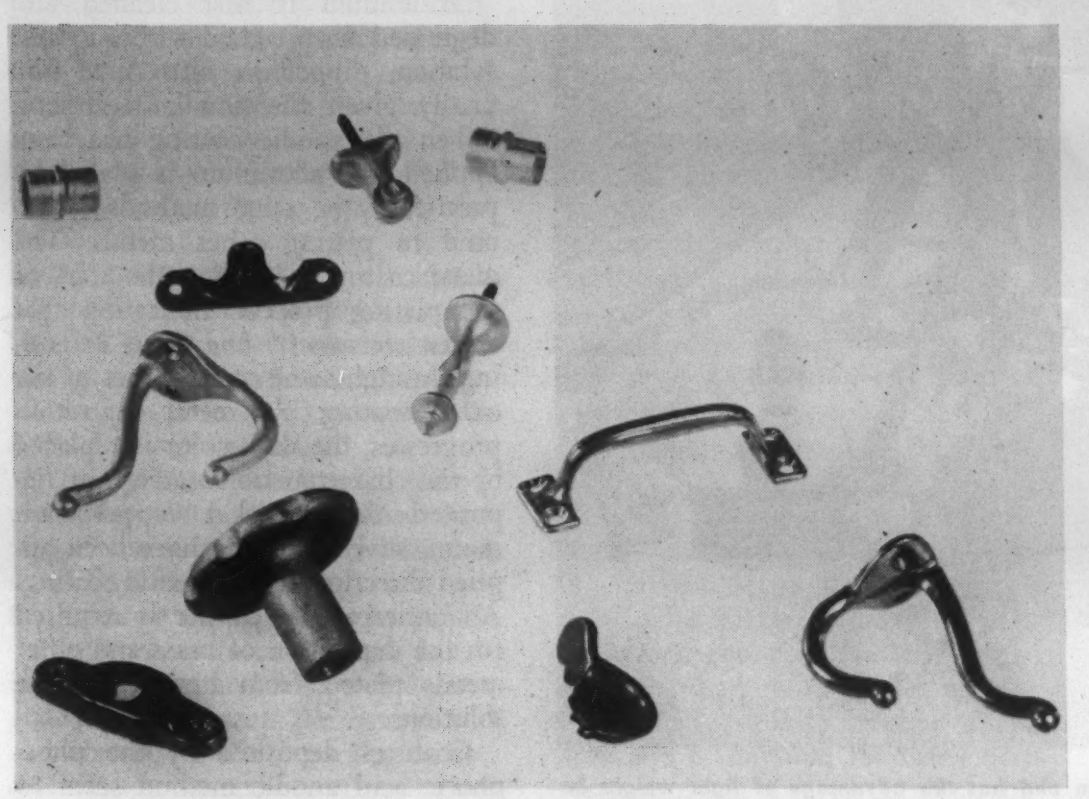




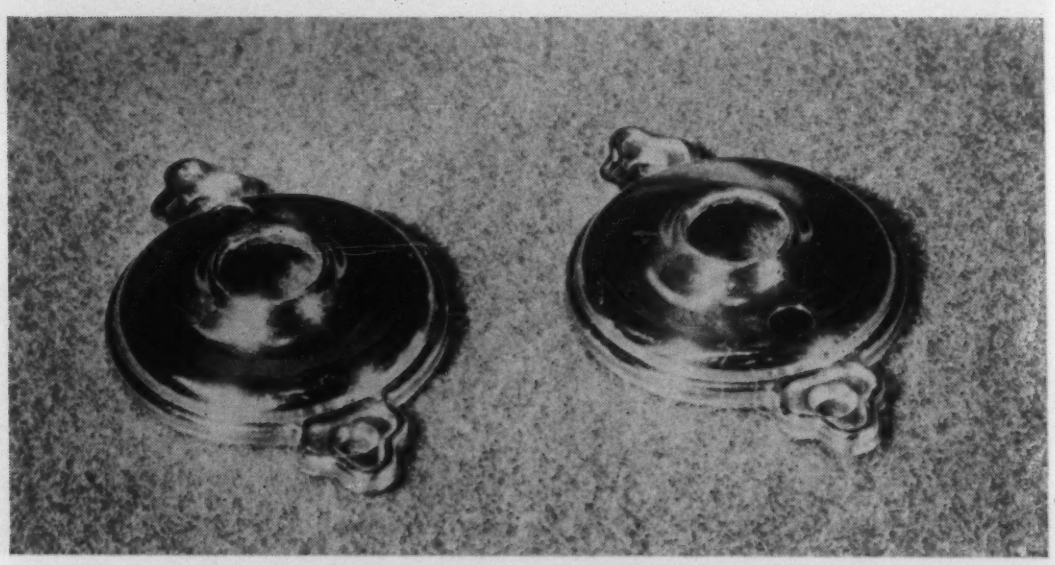
These drawn and machined aluminum parts were electroplated by the Enthone process. Bright nickel-chromium plates and gold plates are used. Baked clear synthetic lacquer adds to the durability of the gold plate. The cold plated parts (bottom) were made by Wire Novelty Co.

vantages to the process, however. It is difficult to plate large areas or irregular surfaces. The process is also sensitive to small variations in alloy composition. It cannot be used successfully with aluminum purer than 2S or with the die casting and sand casting alloys. Copper and magnesium bearing alloys are also difficult to plate by this process.

While the phosphoric acid anodic treatment has many drawbacks, it has, in the past, been used successfully on a commercial basis. Where it is applicable, it gives better adhesion and corrosion resistance to electroplated parts than the Work method. From a theoretical point of view, it is a good plating process for aluminum. The practical difficulties have pushed it out of the commercial field, however.



Aluminum products are being brass, bronze and cadmium plated in production quantities. The cadmium plated articles are used by the Navy and Air Force. (Enthone, Inc.)



Wrought aluminum household hardware is cheap to ship because of its light weight. These pieces were brass plated by the Branford Plating Works to suit consumer preferences.

Zinc Immersion Coating Process

Zinc immersion is by far the most widely used process for plating aluminum at the present time. It requires more baths and more steps than most commercial plating processes, but it is not too difficult to control and can be used, with suitable modifications, with all the commercial cast and wrought aluminum alloys. Essentially, the process replaces the natural oxide skin on the aluminum with a thin zinc coating. Electroplates are applied over this coating.

A uniformly active surface is necessary to obtain consistent results. Oil, grease and other foreign materials are usually removed by vapor degreasing or solvent cleaning. The next step is to remove the original oxide coating and the microconstituents that would interfere with the subsequent processes. Various acid dips and complementary treatments are used for this purpose. The end result is a clean aluminum surface covered by a thin, even oxide coating.

The zinc immersion treatment is the next step. The chief function of this is to remove the oxide coating and replace it with a thin layer of metallic zinc. Since aluminum is less noble than most of the common metals, it replaces them from solutions of their salts. In the zinc immersion bath, the oxide film is removed and replaced by a thin layer of adherent metallic zinc. The zinc coating protects the aluminum in subsequent plating baths, and other metals can be electrodeposited over it.

A copper strike is usually applied over the zinc immersion layer before other metals are deposited. Silver, brass, zinc, nickel or chromium can be plated directly over the zinc, however, with the proper plating techniques.

It is important to keep the zinc

coating as thin as possible. With good process control, the zinc layer is invisible in cross sections of the finished plate. The zinc evidently alloys with the aluminum below and the metal plated on top. If the zinc coating is too thick, the corrosion resistance of the finished product might be lessened.

The exact methods and baths used to form a zinc coating vary. Recently, methods have also been developed to form immersion coatings of cadmium and tin to prepare aluminum for subsequent plating. The zinc coating still seems to be the most practical for most applications, however.

Wet Blasting Process

A relatively new process has been developed to electroplate chromium directly on aluminum with no intermediate coatings. The method is confined so far to wear resistant and anti-friction chromium plating. Wrought, sand cast and die cast aluminum alloys can be plated with equal ease.

This process has only two steps: (1) wet blasting; and (2) chromium plating. The aluminum to be plated is wet blasted by an abrasive suspended in water. This cleans both the dirt and the natural oxide coating from the surface. After being blasted, the aluminum surface retains a coating of the suspension thick enough to prevent any action by air on the mechanically cleaned aluminum long enough to be taken from the blasting solution and immersed in the plating bath. This acid plating bath washes away the coating, which settles to the bottom of the tank. The chromium is then plated directly on the aluminum. The abrasive action of the blasting particles roughens the aluminum, increases the surface area and adds to the bonding action between the basis metal and the plate. The cost of chromium plating by this method is equal to or less than the cost of chromium plating steel by conventional processes. The matte surface of the aluminum results in a dull, rather than a bright chromium plate.

Rubber Coating Process

In addition to these recognized processes some special techniques are used for particular applications. Nickel is being plated on aluminum propeller blades by using an undercoating of electrically conducting rubber. This gives a stress-free, hard resilient coating which protects the blades of sea planes against corrosion when landing and taking off in sea water. Any aluminum alloy can be plated by this method, but the process is comparatively time-consuming and expensive.

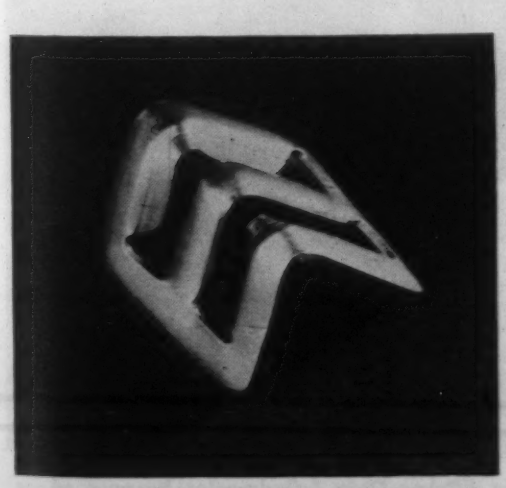
The bond material is sprayed onto the aluminum. After drying, the piece is plated with nickel by conventional methods. Intricate pieces can be plated in this way. The parts have a hardness of 400 to 450 Vickers. A semi-bright surface is obtained, which can be polished to a high luster.

Properties of Electrodeposits

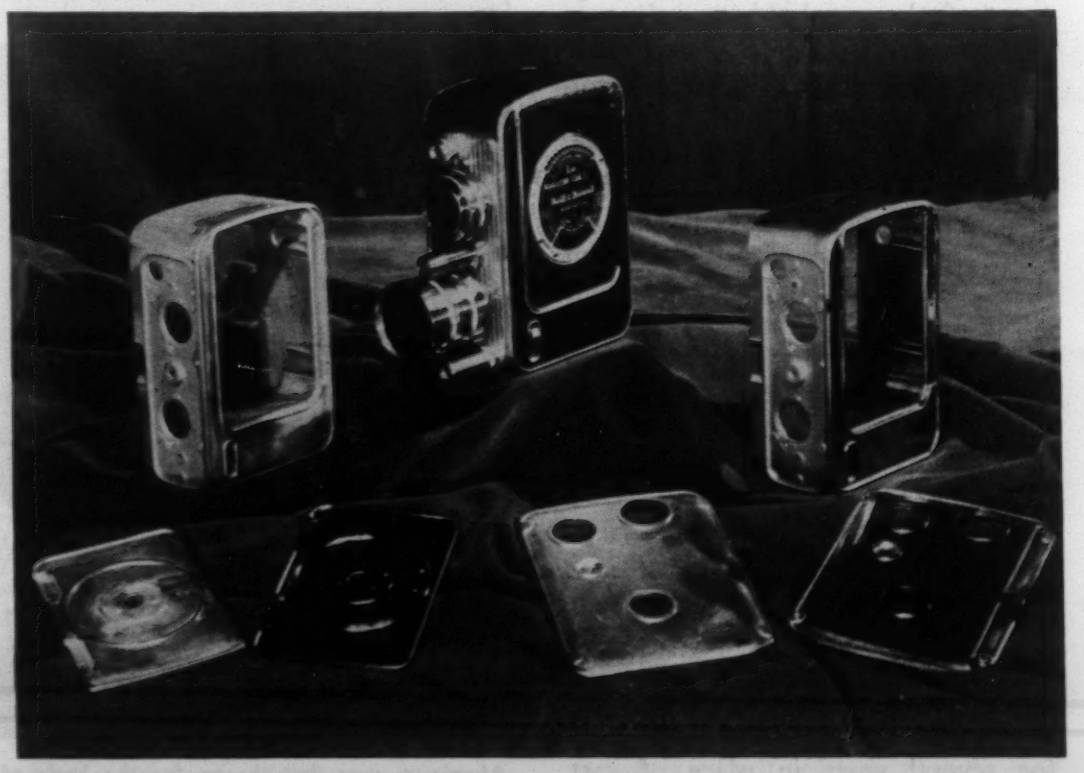
The adhesion of properly applied electrodeposits on aluminum is excellent. A number of commercial applications prove this. In tests, copper-nickel plated aluminum surfaces have been bent a full 90 deg without parting the coating.

Since aluminum alloys will, to some degree, electrolytically protect all the usual coatings except zinc and cadmium, more galvanic action can be expected on exposed anodic areas where several different plates or metal coatings are applied than where there is a single plate. For this reason, from a corrosion standpoint, it is desirable to plate the protective metal, nickel for example, directly on aluminum with no intermediate zinc or copper layer. This performance factor may be overruled, however, by the inconvenience and cost of direct plating methods.

In the presence of an electrolyte, any exposed aluminum acts as the anode and the plate as the cathode. The aluminum is sacrificed in galvanic action. The difference in potential between the aluminum and the coating metal does not seem to be as important as the amount of current that flows. For this reason, a top coating of chromium over nickel plate reduces corrosion on aluminum by reducing the amount of cur-



This aluminum buckle, plated with copper and bright nickel, then bent a full 90 deg, shows the adhesion of electrodeposited coatings on aluminum. (Enthone, Inc.)



Three Alcoa 380 aluminum die castings constitute the frame of this Bell & Howell Co. 8-mm magazine camera. A nickel-chromium plate is applied and the exposed beads receive a brush or butler satin finish. The expense of electroplating is justified by increased durability and improved appearance. As-cast and plated parts are shown.

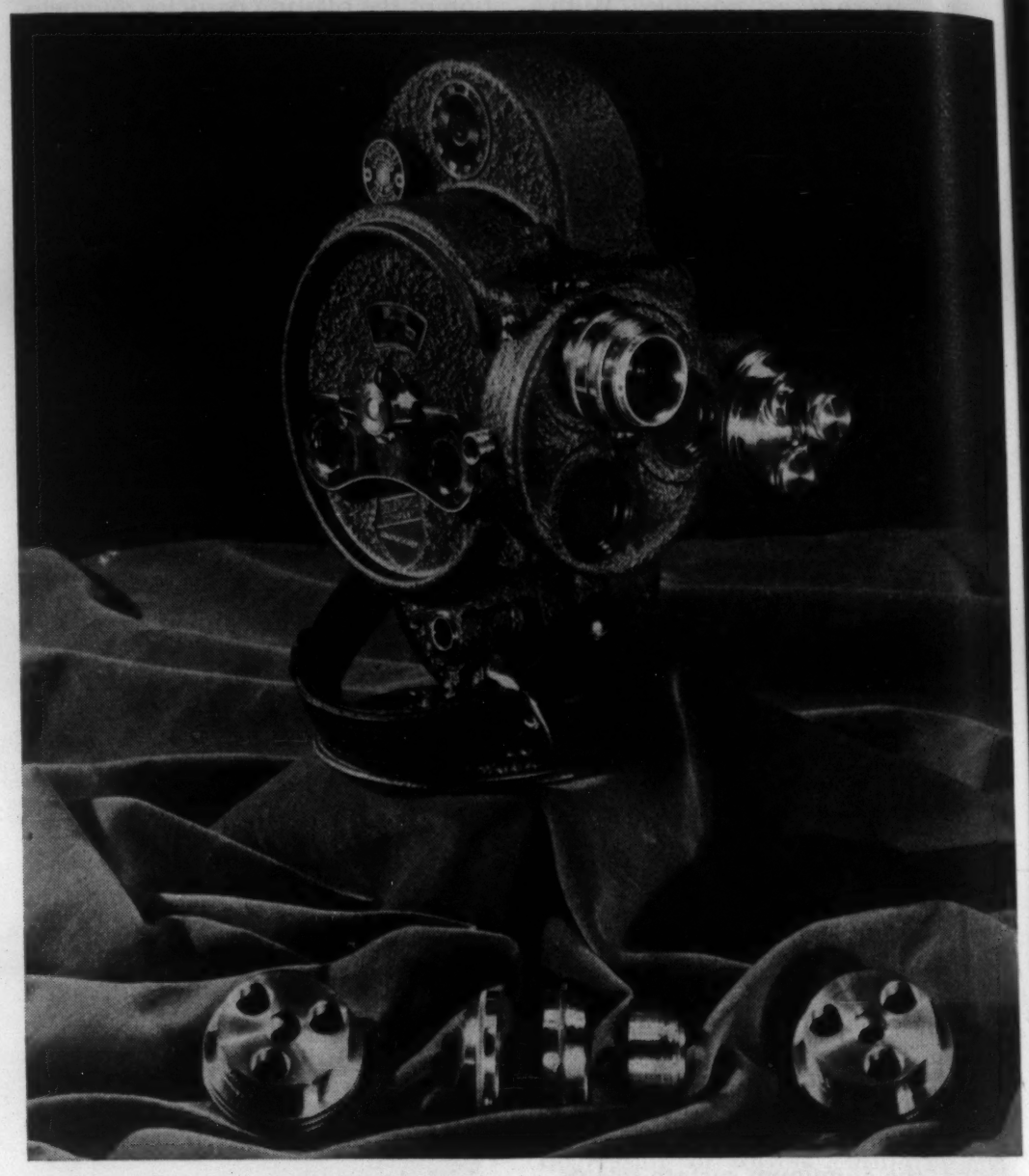
rent flowing from any exposed areas on plated articles. When nickel-plated parts are to be exposed to corrosion, it is also important to use a ductile nickel plate and to avoid highly stressed nickel deposits. Stress cracks develop on highly stressed plates and blistering and spalling result.

With copper-nickel-chromium plates, a total coating thickness of 0.002 in. is necessary to provide adequate corrosion protection in outdoor exposure for a full year. This is somewhat thicker than the coatings required by zinc for similar protection. It is possible, however, that improvements in process control could give more protective coatings on aluminum. Zinc plating is certainly a more highly perfected process at present.

Applications

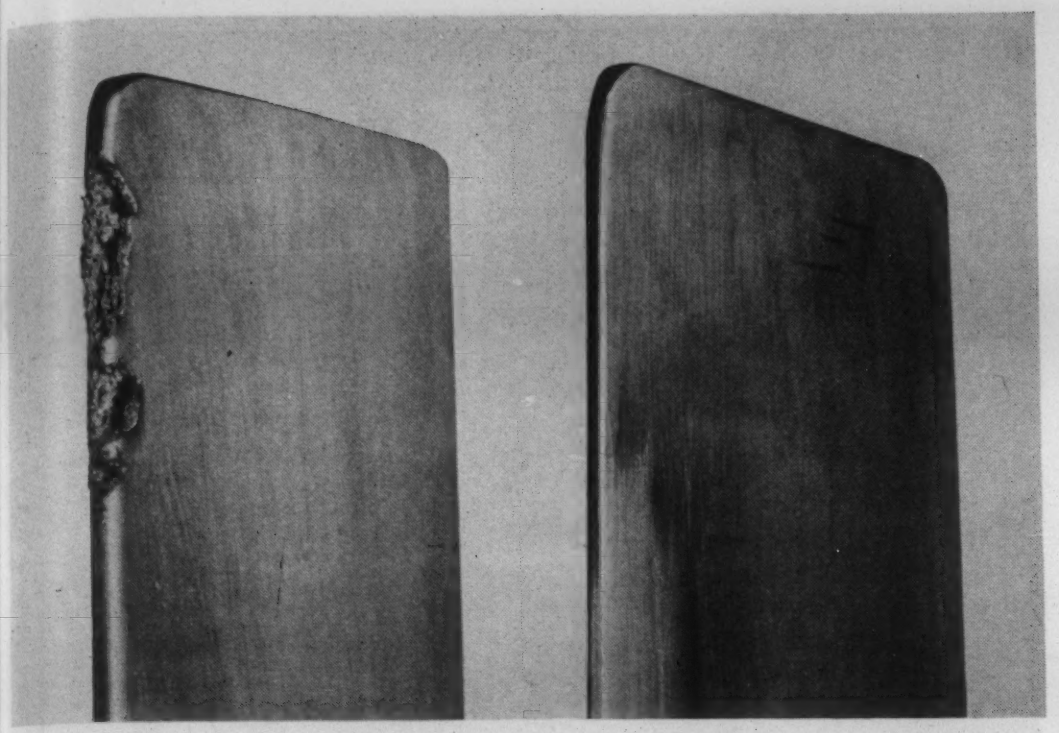
The most important use of plated aluminum is in decorative applications. In most of these parts, added corrosion resistance is not the primary object. The purpose is to get a more pleasing appearance than the dull, natural aluminum surface gives. Copper-nickel-chromium and nickel-chromium coatings are important here. One of the earliest applications were the plated aluminum hub caps on an Essex automobile. At present, movie camera parts are used with a satin chromium plate. Bright chromium plate is used on fishing equipment, flash gun holders and spray gun parts. Hand iron covers have been made of bright plated aluminum. This was a temporary substitution, however, and plated steel is now being used again. Eye glass frames and a deep freezer handle are other production-plated aluminum decorative parts. The most important applications now under study are plated die castings for the automobile industry. Nickel-chromium plated wrought aluminum bumpers and bumper guards have also been tested. In 1948, Chrysler used a plated permanent mold aluminum casting as a bumper piece with acceptable results.

Aluminum is also brass plated for decorative applications. The most important items are household hardware. Cast aluminum has been used for several years in place of cast iron for window locks, coat hangers, door stops and similar items. A considerable amount of successful barrel plating has been done here. Other

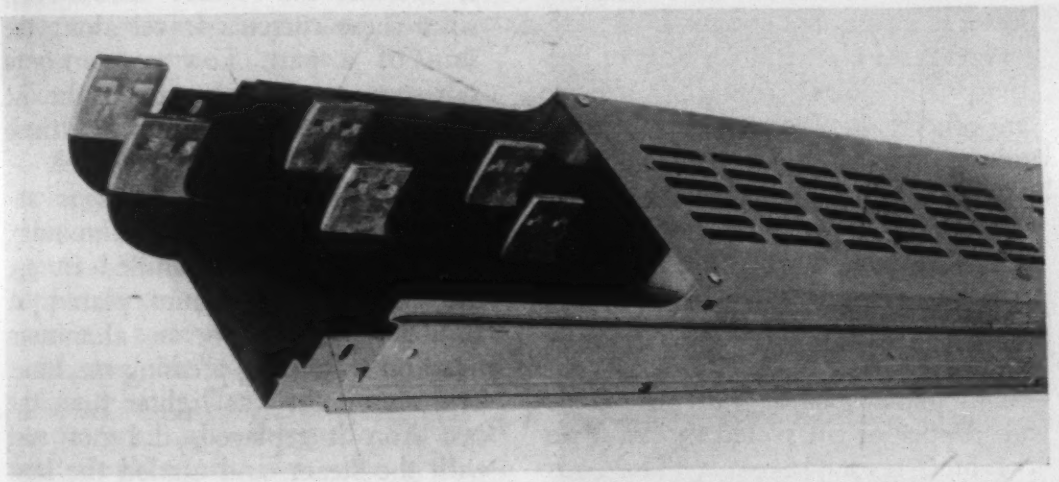


Lens parts on a Bell & Howell Co. 16-mm roll film camera are made from 11 ST-3 aluminum and receive a copper-nickel-chromium plate. The aluminum parts are three times as light as brass. The plated parts can be handled without the formation of grey or black oxide films that appear on uncoated aluminum.

Aluminum was first chosen for the body of the Kitchen-Quip Saladmaster because of its lightness, and because it was economical to die cast. In addition, aluminum was easy to machine. The copper-nickel-chromium plate gave the required appearance. When aluminum became short, the manufacturer changed to magnesium. Both the aluminum and magnesium parts are plated by Imperial Plating and Metal Finishing, Inc.



A hard nickel coating protects duralumin airplane propellor blades from the pitting and eroding effects of spray thrown up in sea landings and takeoffs. The nickel is plated over an electrically conducting coating of synthetic rubber. The plated blades (right) emerged unscratched from Navy tests, while unplated blades (left) were severely eroded. The process was developed by Hamilton Standard Div., United Aircraft Corp., Bart Laboratories Co., Inc., and the International Nickel Co., Inc.



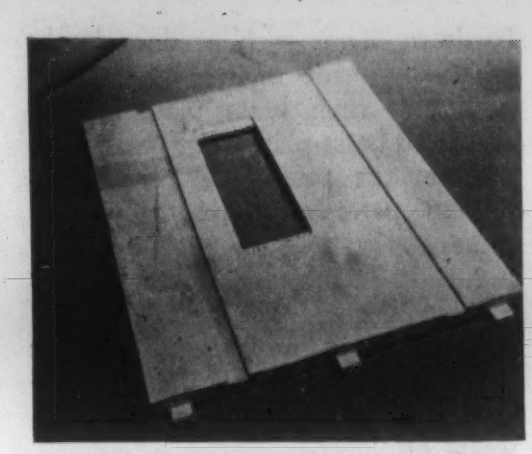
Electrical busways are rated on a given temperature rise at full load. The joints and contacts are the major points of heat generation. These busways may carry up to 4000 amp, and low joint resistance is essential. With copper short, the Trumbull Electric Dept. of General Electric Corp. considered the possibility of taking advantage of the increased availability and the decreasing costs of aluminum. Aluminum oxides have even higher resistance than copper oxides, however, and they form much faster. A silver plate on the contact areas is used to prevent oxide formation. This plating has been satisfactory in extensive tests. Connections between silver-plated copper and silver-plated aluminum give good performance. Trumbull considers plated aluminum in busways more than just a temporary substitution. The performance is equal to that of previous designs; lower weight, flexibility and ease of working are other major advantages.

hardware items such as door knobs are being made of wrought aluminum and then brass plated. Solid brass and brass-plated steel have been used in the past. Brass-plated aluminum parts are advantageous in these applications in that they are lighter in weight and hence cheaper to ship. Plated aluminum does not rust, either; in indoor hardware, the only change is the appearance of the white metal when the brass plate wears off.

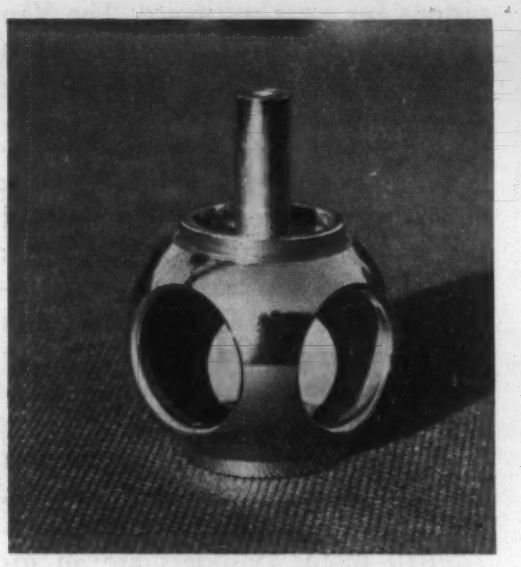
Electroplating is also used to get hard surfaces on aluminum parts. Chromium and nickel coatings are used for this purpose. Pratt & Whitney has plated aluminum hydraulic pistons for wear resistance. The Van der Horst Corp. of America has a special process to porous chromium-plate aluminum aircraft cylinders. Breech blocks for big guns must be light and must pass off heat as quickly as possible. Chromium-plated aluminum fulfills these requirements and provides the necessary wear resistance. The Cro-Plate process has been used to plate aircraft planetary gears, seal rings, a sand cast aluminum variable pitch pulley, and aluminum bearing balls running in a magnesium race in a machine gun mount.

Small motor cylinders are an interesting example of using plated aluminum for a wear resistant application. These cylinders must be light, wear resistant and friction resistant. Anodized aluminum would seem to be the most economical and efficient choice. The high silicon aluminum alloys are the easiest to cast into cylinders, but these alloys do not anodize well. They plate easily, however, so porous chromium plate is the choice.

Plating for joining is another interesting field of application. A brass plate allows rubber to be vulcanized to an aluminum part. Nickel and copper plates are used where aluminum parts must be soldered. Cadmium and tin can also be used as solder plates. Aluminum wire connectors receive a copper-tin coating which is made shiny by immersion in hot palm oil. Aluminum wire sheathing plated with a lead-tin alloy is light and can be soldered without a flux. Plated aluminum is also under study for various types of soldered radiators. Dull nickel plated containers can be hermetically sealed with high melting point solders. Copper plate is used for low temperature solders.



Chromium is plated on the top and sides of the guide slots of this aluminum sawtable to prevent scratches. (The Cro-Plate Co., Inc.)



Aluminum can be used for this globe valve body when the part is chromium plated to protect it from wear. (Van der Horst Corp. of America)

Porous chromium plated cylinders are tested for inside diameter tolerances. The porous chromium increases surface hardness and holds lubricant in operation. (Van der Horst Corp. of America)

Electroplates can also be used to reduce surface friction. Hard chromium plate, for example, sharply reduces friction. The power ratings of small engines was increased by 33% by chromium plating the cylinder bores. Nickel coatings are used on the bores of aluminum airplane landing struts to increase wear resistance and reduce friction. Lead-tin alloy plates on aluminum bearings insure proper break in. Aluminum slide fasteners are zinc plated so that they will move easily in Arctic climates. Zinc coatings are also put on threaded aluminum parts to reduce friction, where ordinary lubricants are not permissible.

Increased electrical surface conductivity and lower contact resistance are other gains from plating. Aluminum aircraft prong-type electrical fittings are cadmium plated. Since these fittings are in contact with steel and copper, they must be protected from galvanic corrosion. An anodic coating would increase the contact resistance, though, so a cadmium plate is used. Wire terminals are copper or tin plated to eliminate the high resistance oxide. The ends of aluminum bars in plant current distribution bus systems are silver plated for the same reason. The silver plate gives good contact between the bar ends.

Silver-plated aluminum is also coming into use in switch gear parts now made of plated copper. Electric and electronic aluminum chassis are other silver plate applications. Aluminum parts that carry high frequency currents are also silver plated to increase the surface conductivity, since these currents travel along the skin of a part. Low resistance to salt spray tests has hampered the use of silver-plated aluminum in these particular applications, however.

The need for cleanliness is another reason for plating aluminum. Parts that must be handled in use can be nickel-chromium plated. A similar use was on an aluminum head on a clothing pressing machine. The aluminum was lighter than the cast iron it replaced, did not rust with the steam, and carried the heat away better. The only drawback was the oxide on aluminum, which absorbed dyes from colored cloth and then soiled white material. A chromium plate on the aluminum solved the problem.

There are a number of other specialized plated parts. Hearing aids are rhodium plated. Jewelry is gold, silver and brass plated. Name plates receive a black nickel plate.

Electroplating Magnesium and its Alloys

For many years, electroplating on magnesium and its alloys was a problem that defied practical commercial solution. Magnesium is less noble than any of the common metals, and replaces many of them from solutions of their salts. Magnesium is also active in many neutral and most acid solutions, and a hydroxide forms on its surface in almost any water solution. Insufficient adhesion of the electroplate to the

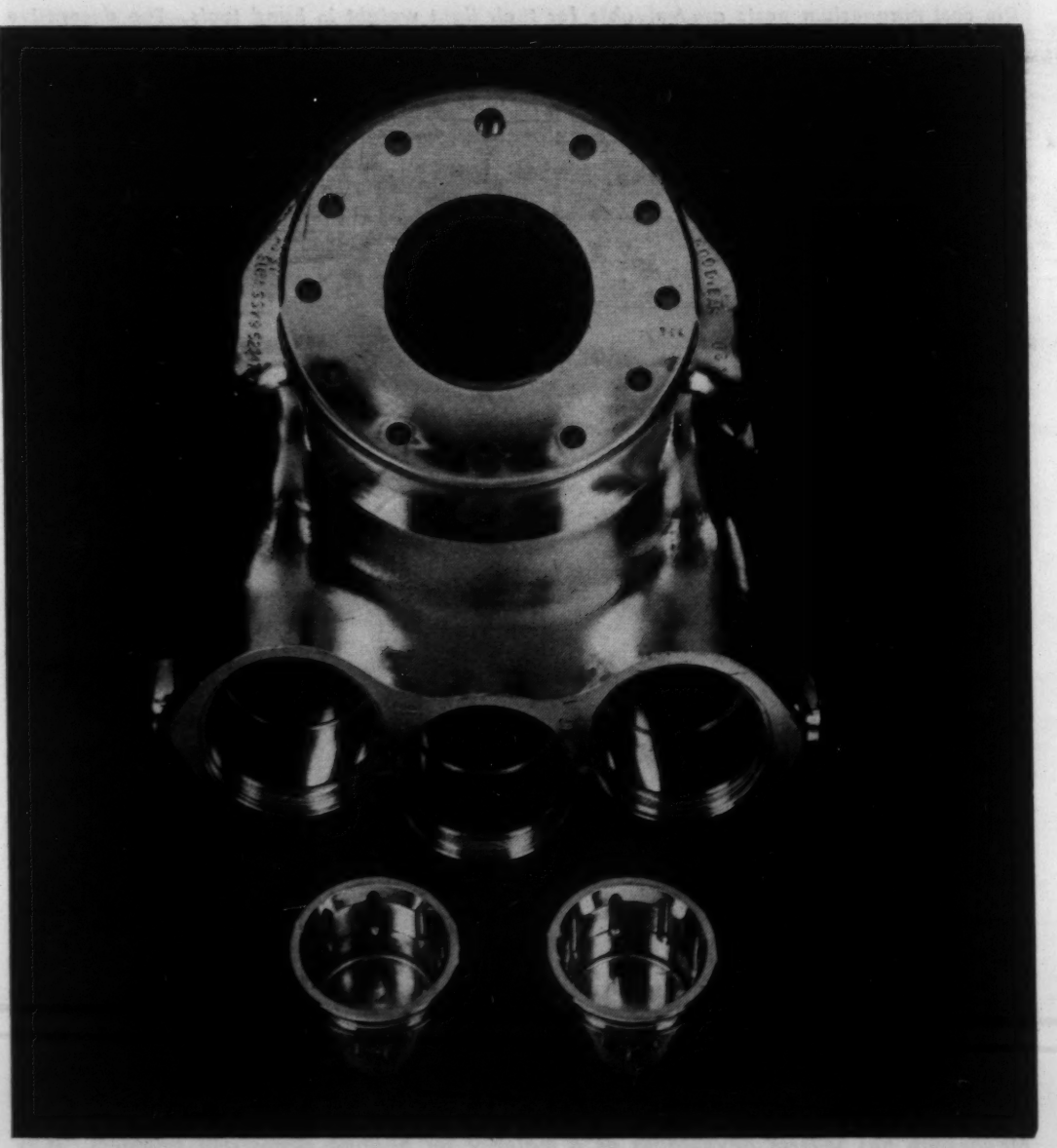
Magnesium alloy screw machine parts are barrel plated. A practical plating process for magnesium has been developed only recently by the Dow Chemical Co.

surface was the stumbling block in most of the suggested processes. Control difficulties ruled out other methods.

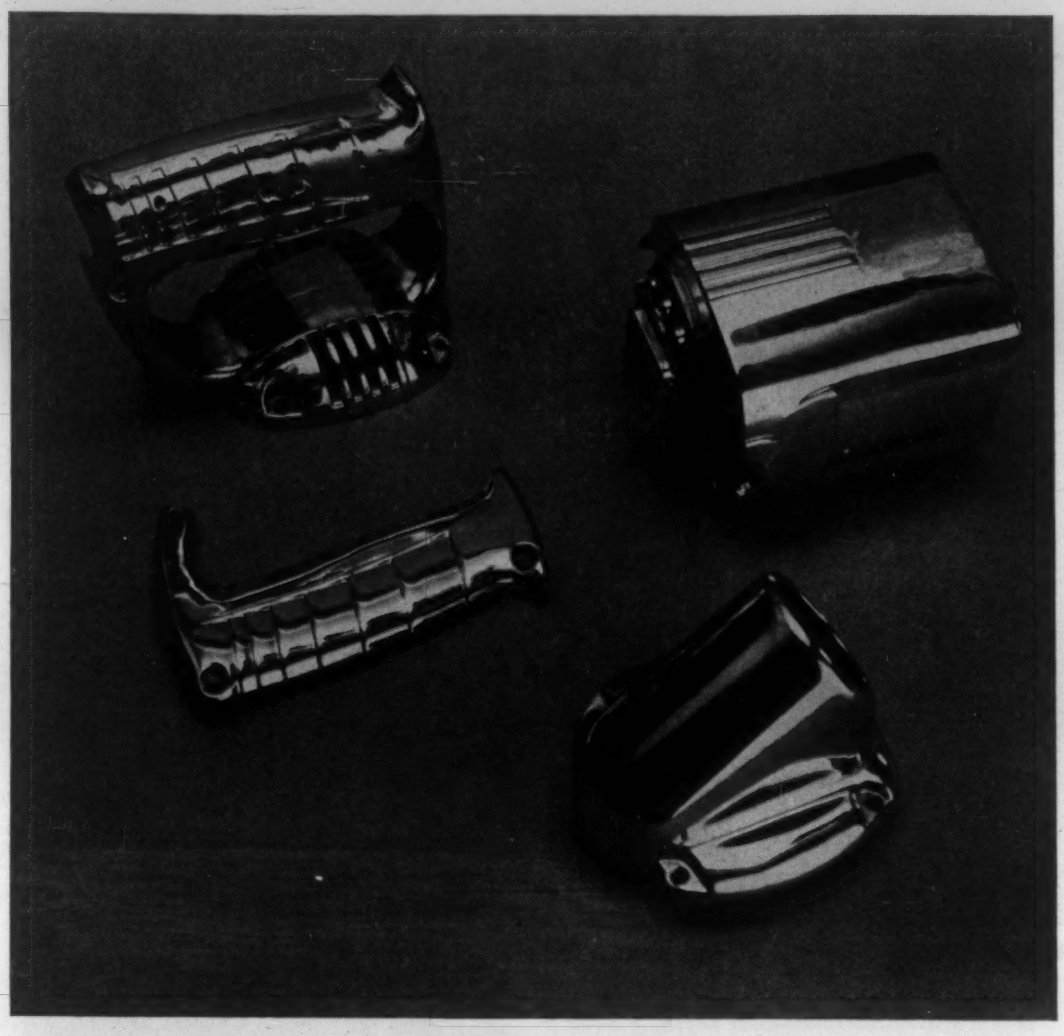
A practical process has been developed by H. K. DeLong of the Dow Chemical Co., however. In general, this consists of the initial application of an immersion zinc coating, followed by a copper strike and then electroplating in standard plating baths. Excellent adhesion and appearance are obtained. Commercial applications have already been found for parts that require a bright tarnish-resistant surface or added wear resistance.

Surface Preparation

The surface must be free of nonmetallic contamination such as oxide or hydroxide coatings, mill scale, dirt, oil, grease and chemical coatings. Parts are degreased and pickled to remove these foreign materials. Mechanical polishing and buffing are often used in conjunction with cleaning methods. Pickling tends to remove intermetallic compounds and precipitates in castings. Parts that are reasonably free of nonmetallic inclusions and oxide coating might not require pickling, however. Polishing and buffing are used after pickling when a smooth, polished surface is desired on the plated part.



Nickel plated magnesium aircraft brake assembly parts are light in weight, resist wear and resist attack by the synthetic brake fluids that are used., (Dow Chemical Co.)



Die cast magnesium parts are valuable for their light weight in hand tools. The decorative electroplate also makes the tools pleasant to handle. (Dow Chemical Co.)

Magnesium has several advantages as a material for printing plates and cylinders. It is rapidly etched and resists wear well. The light weight of the metal permits higher press speeds. Chromium plating increases the wear resistance even more. (Dow Chemical Co.)

After the magnesium parts have been prepared by some combination of degreasing, pickling and buffing, a zinc immersion coating is applied. This is the most important part of the process. Magnesium replaces many of the common metals from solutions of their salts. Alkaline pyrophosphate solutions dissolve the oxide and hydroxide coatings from magnesium, and when certain zinc salts are added to the solution, an adherent zinc film is formed. This film of pure zinc is less than 0.0001 in. thick, but it is continuous.

Electroplating

The next step is usually to apply a copper strike over the zinc coated part. This strike is applied in copper cyanide electroplating baths. Copper can be plated to greater thicknesses by prolonging the time in the strike bath or by transferring the work to other alkaline copper cyanide or pyrophosphate baths. Proprietary bright copper plating baths are satisfactory for building up thick plates, although some of these baths must be modified.

Other metals can also be plated over the copper strike. Nickel can be applied from any of the conventional baths. A copper plate at least 0.0005 in. thick is required to prevent attack of the magnesium in nickel plating. As much as 0.0008 in. of copper may be required to nickel plate deeply recessed parts in some solutions. Cadmium, zinc, brass, silver and chromium can also be applied from standard baths over the copper strike. It is preferable to apply a heavy copper plate and a nickel strike before plating silver, however, in order to obtain the best adhesion between the copper and silver. Nickel can also be applied over the copper before chromium plating.

In some cases the copper strike can be dispensed with, except when electroplating nickel, silver and copper. Cadmium, brass, zinc and chromium can all be plated directly over the zinc immersion coating. Better results are obtainable with zinc and cadmium when the copper undercoat is used, however. Direct chromium plating is limited to simple shapes.

From a production standpoint, the Dow process does not present any particular problems. Conventional non-magnesium racks can be used. Barrel plating similar to that used

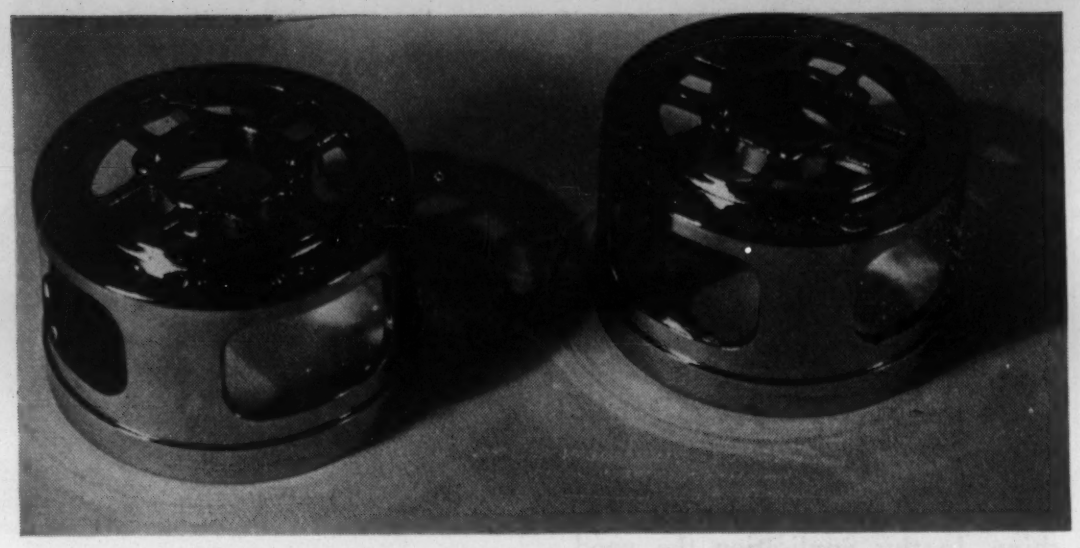
with other metals can be used on small magnesium parts. With suitable care, deposits can be stripped.

Properties of Electrodeposits

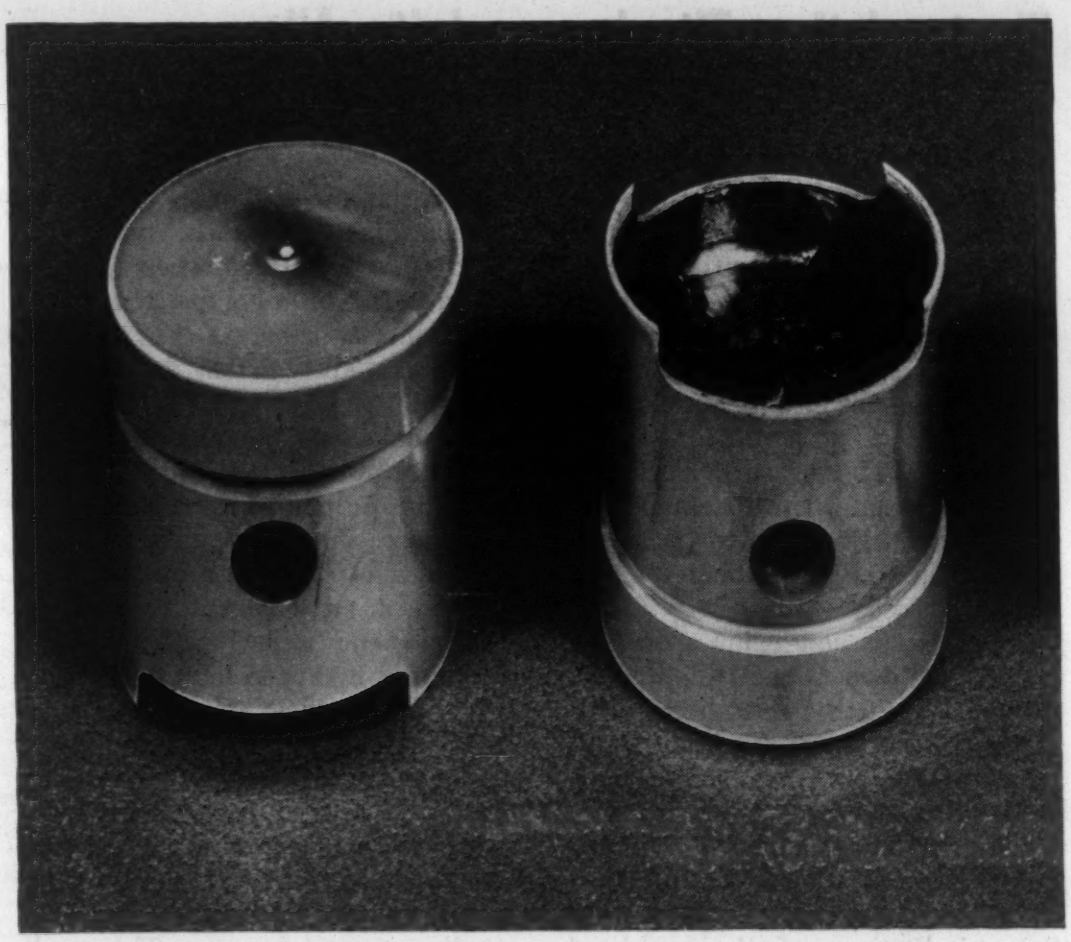
The adhesion of electrodeposits laid down by the zinc immersion treatment method is reported to be good. Heating affects adhesion on castings more than on wrought products. There is no general lifting or blistering of deposits on wrought magnesium up to the melting point of the metal (1100 to 1200 F). On castings, electroplates may fail in adhesion above 450 F. Plated parts can be hammered and bent without failing. Copper and silver plates can be soft soldered without damaging the bond. Under mechanical wear, heavy chromium plates (0.005 in.) have shown no tendency to peel. Some indication of the adhesion obtainable with the right plating procedures is given by thermal shock tests on an experimental commercial part. A magnesium casting with a copper-nickel-chromium plate 0.0015 in. thick was quenched from 700 F without damaging the coating.

General corrosion tests such as salt spray, high humidity, interior exposure and exterior exposure indicate good performance for these coatings. Chromium-plated parts have been exposed in a laboratory atmosphere for two years with no corrosion or blistering. Some of these parts carried as little as 0.0005 in. of nickel under the chromium. The time of failure of copper-nickel-chromium deposits in salt spray tests seems to depend mainly on the thickness of the nickel deposit. Silver- and chromium-plated test panels have shown little blistering or corrosion after 90 days at 95 F at high humidity. Rural exposure tests for 6 months on chromium-plated test panels showed no failures. Silver-plated panels blackened in 3 months but the magnesium was not attacked.

While the adhesion of coatings deposited by this method is definitely better than that obtained with other processes, there are no reliable general rules as yet established on the corrosion resistance of the coatings. Actual tests under service conditions are the only real guide. Some experience has been obtained, however. The Dow Chemical Co. suggests minimum total plate thickness of decorative copper-nickel-chromium plating of 0.00075 in. for interior, 0.00125 in. for mild exterior, 0.0015 in. for average exterior and 0.002 in. for severe exterior exposure.



These die cast magnesium machine parts were plated by the Dow Chemical Co. All the magnesium alloys can be plated with the right procedures.



Magnesium alloy pistons are electroplated for wear resistance and better frictional properties. The plate is 0.0005-in. copper, 0.001 chromium. (Dow Chemical Co.)

Applications

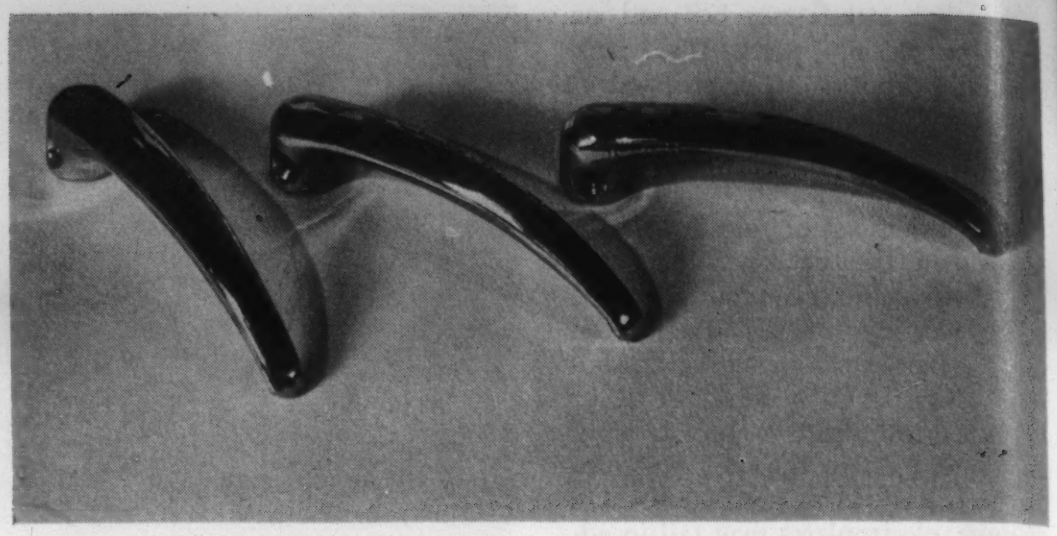
The applications of electroplated magnesium will be similar to those of plated aluminum. The magnesium plating process, being newer, is not in as wide use as yet, however.

The biggest use is in chromium-plated magnesium printing plates. The chromium is put on to increase wear resistance. With bare magnesium, the average life of printing plates was 500,000 impressions. A 0.0002-in. hard chromium plate increased the average life to 33,000,000 impressions.

Nickel is also plated on magnesium to increase wear resistance. An example is a nickel plated part used in an airplane hydraulic brake system. Lightness was essential, so magnesium was chosen for the part body. Wear was a problem with bare magnesium, however, and the metal was attacked by the synthetic hydraulic fluids used. A nickel plate solved both these problems and the

part has given highly satisfactory performance in service.

Copper-nickel-chromium coatings are growing in use for decorative purposes on magnesium. Parts for hand tools are a typical application. These parts must be light for portability and for easy handling in use. Magnesium gives the required light weight and can be die cast in intricate shapes. The decorative plate makes the parts pleasant to handle and improves their appearance. The same advantages recommended plated magnesium for a food preparing machine. In this application the good machining qualities of magnesium were also advantages in production.



Die cast magnesium aircraft door handles are copper-nickel-chromium plated, with 0.0005 in. of copper and 0.00175 in. of nickel. (Dow Chemical Co.)

Electroplating Titanium and its Alloys

Although titanium has good corrosion resistance, all of its other properties are not necessarily as good. For instance, erosion and wear resistance are not outstanding in titanium, so that if a method of obtaining adherent electrodeposits were known, these properties might be improved. Thus, as with aluminum and magnesium, the problem of plating on a relatively active metal enveloped in a tightly adherent, thin oxide is posed.

A project is now being sponsored by Watertown Arsenal at the Armour Research Foundation of the Illinois Institute of Technology to develop methods of obtaining adherent metallic coatings on titanium by electrodeposition. The work is still going on, and any report is bound to be obsolete as soon as it is written. Some indications of the problems and objectives of plating titanium can nevertheless be obtained from the preliminary reports of the Armour researchers.

The initial stages of the project were concerned with trials of presently known methods of plating on oxide covered reactive metals such as stainless steel, magnesium and aluminum. Cathodic reduction of the oxide and simultaneous deposition of a strike metal (nickel) as is practiced with stainless steel gave non-adherent plates. Zinc immersion plates in alkaline baths or acid fluoride baths gave similar unhappy results. It was reasoned from these experiments that the presence of water was causing oxidation of the titanium as fast as the oxide was being reduced or removed. The program was accordingly directed toward non-aqueous baths.

It was known that hydrofluoric acid was quite effective in removing titanium oxides in aqueous solution. This acid was tried as the activating agent in the non-aqueous bath. Since the more active metals form better strikes than the noble metals when plating on an active metal, zinc was used as the strike metal. Finally, anhydrous hydrogen fluoride requires a polar molecule to manifest its acidic properties; therefore, a polar organic solvent was required. The bath which gave best results from the standpoint of adherence was one composed of zinc chloride, hydrogen fluoride, acetic acid as solvent and a small amount of water. The small amount of water was added to give the bath appreciable d.c. conductivity. Water was present in small enough quantity to be tied up by the hydrogen fluoride and, therefore, was unavailable to oxidize the titanium.

The adherence of some specimens struck in the non-aqueous bath and subsequently copper plated was excellent. Adherence was tested by clamping half the specimen in a vise and beating back the exposed part until either the metal failed or the plate parted from the base metal. In those cases where the adherence was considered excellent, the specimens required bending through an angle of 180 deg before the metal failed.

A serious drawback to the non-aqueous bath was the inconsistency of adherence. Completely adherent plates could not always be produced. Apparently either the conditions of plating were extremely critical or the bath suffered some form of deterioration. In either case, this factor was detrimental.

Development work is continuing and other results, not yet cleared by Defense authorities, have been obtained. In any case, it seems likely that a practical process for plating on titanium will be developed. No applications, or even intended uses, have been announced, however. Corrosion resistance and adherence properties are also unavailable.

Acknowledgments

We wish to acknowledge the help we have received from the publications and personnel of the following organizations:

Advance Aluminum Castings Corp.
Aluminum Co. of America
American Electroplaters' Society
American Society for Testing Materials
Armour Research Foundation
Bell & Howell Co.
Burndy Engineering Co., Inc.
The Champion Hardware Co.
Collins Radio Co.
The Cro-Plate Co., Inc.
Dow Chemical Co.
Enthone, Inc.
International Nickel Co., Inc.
Kitchen Quip, Inc.
The Glenn L. Martin Co.
Northwest Chemical Co.
Pennsylvania Salt Mfg. Co.
Philadelphia Rust-Proof Co.
The Troy Sunshade Co.
Trumbull Electric Dept., General Electric Co.
Van der Horst Corp. of America
Westinghouse Electric Corp.

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Materials Engineering File Facts

NUMBER 228
June 1952

Relative Workability of Representative Stainless Steels

In general, the stainless steels offer greater resistance to plastic deformation than the carbon and low alloy steels and they are less readily machined. Difficulties with fabrication increase with the alloy content, as a rule, in each group. In the table below, types 303 (free-cutting grade), 304, 316, 321, 347 and 310 are austenitic; type 420 is martensitic; and types 430 and 446 are ferritic.

Type	303	304-316 321-347	310	420	430	446
Air-Hardening?	No	No	No	Yes	No	No
Anneal (Temp. F and Cooling Medium)	1900—water	1900—water	1900—water	1450—furnace	1350—air	1500—air
Blanking	Good	Fair	Fair	Good	Good	Fair
Brazing	Poor	OK	OK	OK	OK	OK
Buffing	OK	OK	OK	OK	OK	OK
Coining (Cold)	Fair	Good	Good	Fair	Good	Fair
Deep Drawing	Slight	Good	Good	Slight	Good	Poor
Embossing	Fair	Good	Good	Slight	Good	Good
Forming (Hot)	OK	OK	OK	OK	OK	OK
Forming (Cold)	Fair	OK	OK	Fair	OK	Poor
Grinding (Ease)	Good	Fair	Fair	Good	Fair	Good
Grinding (Is It Magnetic?)	No	No	No	Yes	Yes	Yes
Harden (Temp. F and Cooling Medium)	Does not harden	Does not harden	Does not harden	1825—oil	Does not harden	Does not harden
Machinability	Good	Poor	Poor	Fair	Fair	Poor
Punching (Perforating)	Fair	Fair to Poor	Fair to Poor	Fair	Fair	Poor
Polishing	Good	OK	OK	OK	OK	OK
Flaring	No	Good	Good	No	Fair	Poor
Upsetting (Cold)	Slight	OK	OK	Slight	OK	Poor
Welding	Poor	OK	OK	OK	OK	Poor
In All Hot Working Operations, Look Out for:	Intergranular corrosion	Intergranular corrosion	Intergranular corrosion	Air-hardening	Grain growth	Grain growth

Courtesy of J. Bishop & Co. Platinum Works

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AND PROFITS ON
DECORATIVE LAMINATES
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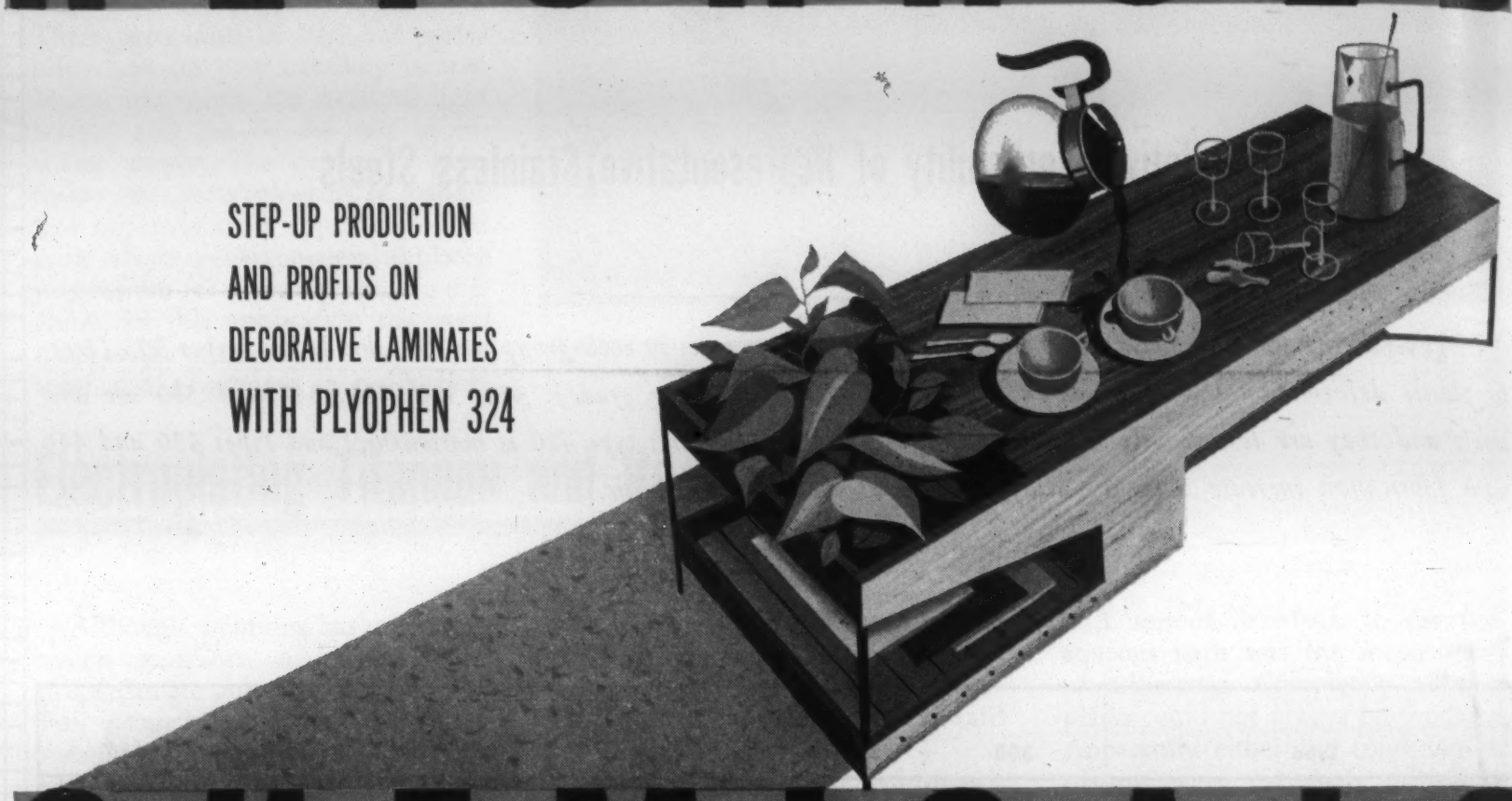

CHEMICALS

• Developed especially for the manufacture of filler sheets for decorative laminates, RCI's PLYOPHEN 324 cuts treating machine time by as much as 50-75%, affords phenomenal treating machine yields, possesses excellent storage stability and meets all NEMA specifications for materials of this type. An alcohol-soluble phenolic resin, PLYOPHEN 324 has the same flow characteristics as the resins commonly used in applying the decorative surface sheet, thereby assuring an attractive product free of any appearance-marring defects. For complete information and a working sample, write direct to:

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Osaka, Japan • Gothenburg, Sweden • Zurich, Switzerland

Materials Engineering File Facts

NUMBER 229
June 1952

MATERIALS:
General

Price-Volume Ratios for Plastics and Metals

Raw material prices per pound based on April 1952 quotations.
Graphs on left represent volume in cu in. per dollar.

Dollars per lb	Lb per dollar		Cu. In. per lb
1.60	0.6	Polyamide (Nylon) 15.2	24.3
0.70	1.5	Acrylic 33.8	23.1
0.72	1.4	Ethyl Cellulose 34.2	24.8
0.62	1.6	Cellulose Acetate Butyrate	23.1
0.47	2.1	Melamine 39.2	18.5
0.54	1.8	Vinylpolymers 42.8	23.1
0.46	2.2	Cellulose Acetate 45.6	21.0
0.55	1.8	Polyethylene 54.8	30.1
0.33	3.8	Urea 56	18.5
0.32	3.1	Polystyrene 81.5	26.2
0.20	5.1	Phenolic 111	22.2

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0.0236	42.4	Cast iron 143	3.8
0.0413	24.2	Steel 86	3.5
0.245	4.1	Magnesium 64.7	15.9
0.19	5.2	Aluminum 56.8	10.8
0.195	5.0	Zinc 20.1	4.0
0.19	5.2	Lead 12.8	2.4
0.245	4.1	Copper 12.8	3.1
0.272	3.6	Brass 12.3	3.3
0.335	3.0	Bronze 9.5	3.2
0.596	1.7	Nickel 5.3	3.2
1.215	0.8	Tin 3.1	3.8
6.00	0.2	Titanium	6.2

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New Materials and Equipment

New Foaming Plastisol Has High Flame and Chemical Resistance

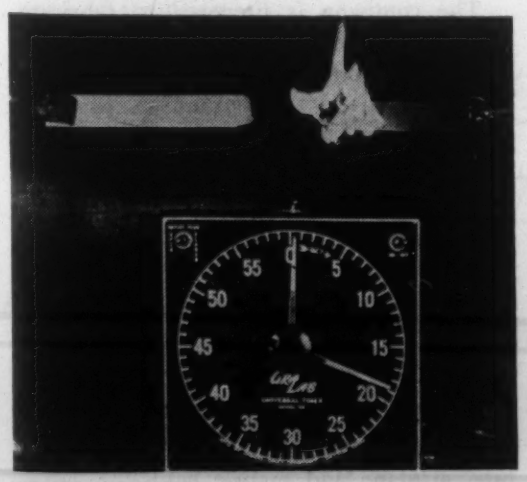
A new and economical method of foaming Vinylite plastisol produces material similar to foam rubber but with more flame resistance, chemical resistance and ease of fabrication. Because the new foam is made with inexpensive equipment in low-cost molds and can laminate directly to textiles and films, its cost is said to be comparable with foam rubber in fabricated form.

Developed by *Elastomer Chemical Corp.*, Nutley, N. J., together with research by *Bakelite Co.*, Div. of Union Carbide & Carbon Corp., 122 E. 42nd St., New York 17, this process produces the new foam by expanding a special compound, based on Vinylite plastisol resins, that cures at low temperature. The foamed material enjoys the important advantages of flame resistance, flexibility, light weight, and resistance to aging, moisture, abrasion, tearing, alkalies, acids and most chemicals. Because of these inherent properties, the new foam does not oxidize, dry out or harden; it has high resilience and elasticity; it is practically odorless and can be made in any color. The foaming process is completed in three simple stages at low temperatures and pressures, eliminating use of expensive high-pressure equipment.

Laminated to natural and synthetic fiber textiles or Vinylite plastic film and sheeting, the springy foam makes an excellent cushion backing for furniture upholstery. Laminates of more than an inch in thickness are easily coated and cured in place on any width of fabric or film. Cast in an inexpensive open mold without coring, this foam also produces resilient seat cushions three or more inches deep. The versatile foam is easily molded in intricate shapes; in sheets of any width and thickness; and tubes or blocks up to 8 in. or more in thickness. This material can be die cut to any shape or sliced as thin as 1/32 in. Foam laminates on Vinylite plastic film can also be heat-sealed or embossed electronically or with heated rollers.

The method of foaming Vinylite plastisol is said to be easy to control and at no point to be a critical chemical or technical process. Both the special compound based on Vinylite plastisol resins and the expanded material are stable. Compound, gas pressure and temperature of cure can be varied within fairly wide limits. The density of the foam can thus be varied from 12 to 18 lb per cu ft, and the expansion from 400 to 800% by simply varying the formulation or foaming process. Similarly, almost any degree of hardness or softness can be obtained as well as any hue or shade of color.

Available in any color or thickness, this soft foam has a high resilience and elasticity; is resistant to oxidizing or hardening.



Less than 19 sec. after the burner was removed, the flame-retardant plastic has stopped burning, and exhibits no afterglow.

Flame-Retardant Laminated Plastics Offer Many Possibilities

Flame-retardant laminated plastics expected to have wide usefulness in electronic, aircraft and other applications are now being offered by *Synthane Corp.*, Oaks, Pa. The increased safety provided by use of a new resin formulation is available in all standard grades and forms of Synthane plastics. Incorporation of the flame-retardant feature is said to have no detrimental effect on punching or other machining properties, and is available at a very slight increase in cost over that of the standard laminates.

Test procedures have been worked out in cooperation with Underwriters Labs., Inc., but in advance of any adopted code of performance for such materials, testing calls for the suspension of a strip in the flame of a Bunsen burner for 15 sec. and its removal for 15 sec. On the fifth repetition of this cycle, the flame must extinguish itself within 60 sec., and actually does so in less than one-third of that time.

First widespread application of the new material is in the chassis of television receivers where sizeable sheets of metal-clad laminate are used in printed circuitry. Electrical components, such as circuit breakers, and aircraft equipment, where the absence of afterglow may be important, are two of the many fields where the new material offers important advantages.

New Materials and Equipment continued

New Adhesive Formulation Developed for Aluminum

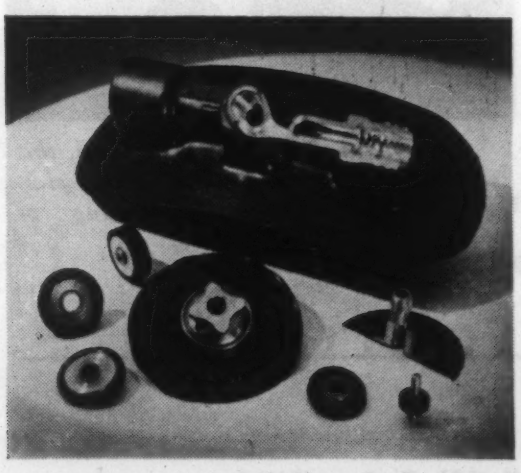
An adhesive said to be strong enough to make lap joints in aluminum alloy sheets for airplane construction has been developed by *Ciba Co., Inc.*, Kimberton, Pa. Newly developed adhesives in some instances have the full strength of the Alclad aluminum, according to tests. Strength in shear is comparable to spot welding and riveting, and sometimes higher.

Adhesives being tested by the company are its Araldite resins, which consist of many variations of a new group of ethoxylene oxide compounds with acid, anhydrides, amines, and other compounds as hardening agents. All of the resins are thermosetting compounds which cure without evolution of water or volatile matter at room or elevated temperatures. The general result is an adhesive of high resistance to acids and alkalies. Use of this class of resin adhesives solves many problems that were previously difficult: for example, the bonding of metallic materials to nonmetallics and unlike metals to each other.

Shear tests are made on a Baldwin-Sonntag 12-H hydraulic testing machine of 12,000 capacity (Baldwin-Lima-Hamilton Corp., Philadelphia 42). Test specimens consist of two 1-in. strips of 16-gage Alclad aluminum bonded together with an overlap of ½ in. to form strips 11½ in. long. Tensile loads as high as 2500 lb have been applied on the half-square-inch bond before failures in shear. Dial indicated loads are recorded. Lever operated, open front, face type grips permit rapid testing.

In preparation for tests, adhesive is applied to the 5-in. edge of two 5- by 6-in. sheets of 16-gage Alclad. Several pairs of these sheets are overlapped on these edges in a jig which assures a ½-in. overlap without measurement. A clamp is then placed on the jig so as to hold the several adhered surfaces tightly together. The whole assembly is then heated in an oven to set the adhesive. After removal from the oven, four test specimens 11½ in. long and 1 in. wide are sawed out of each pair of sheets. One-half in. strips are sawed off each side and discarded to assure continuous bonds in the specimen.

Shear tests of Ciba's Araldite resin adhesives in lap joints of Alclad aluminum strips are made on this Baldwin-Sonntag 12-H testing machine.



These rubber-bonded-to-metal parts can be fabricated from natural or reclaimed rubber stocks and from synthetics.

Molded Rubber Shapes Bonded to Metal or Ceramics

The *Andrews-Alderfer Co.*, 1091 Home Ave., Akron 10, has announced the availability of highly specialized or custom-fabricated parts consisting of molded rubber shapes bonded to any ferrous or nonferrous metal component or to various ceramic compositions. A wide variety of sizes and shapes can be produced for application in processing equipment of all types, control valves, electric control devices, conveyors, heat treating equipment, electrical switches, contacts, controllers, etc.

Intricate as well as simplified parts can be fabricated from natural or reclaimed rubber stocks and from such synthetics as Buna S, Buna N, Neoprene, Butyl and Thiokol. These parts can be supplied having tensile strengths ranging from 500 to 3500 psi. In addition, durometer hardness can range from 30 to 100 and elongation from 50 to 900%.

According to the company, rubber-bonded-to-metal parts can be furnished which will remain stable upon exposure to temperatures ranging from –75 to 200 F. Special stocks featuring maximum resistance to abrasion, weathering and various chemicals can be utilized in the production of parts requiring these properties.

The company is prepared to fabricate parts meeting SAE or ASTM specifications or the requirements of individual applications.

Polyester Laminated Sheets Have Good Properties

Industrial Organics Corp., 59-31 54th St., Maspeth 78, N. Y., has announced the production of Iolyte polyester laminated sheets in continuous strips of any desired length, in thicknesses from 8 mils to ¼ in. or more. Although it has the tensile strength of steel, pound for pound, Iolyte is only one-fifth its weight, making it lighter than aluminum or magnesium.

Among the many properties claimed for the new product are: it withstands continuous exposure to temperatures up to 350 F; it has low water absorption; good electrical properties; it is practically shatterproof and scratchproof; it is highly resistant to chemicals; stainproof; easy to machine, saw, drill, stamp, nail, glue.

Iolyte can be fabricated into ducts, pipe, tube, tanks, or into molding shapes, and its properties are claimed to make it useful for structural and decorative forms, products in the electrical, electronic radio, chemical, furniture, machinery, automobile, airplane and marine fields.

The filler can be Fiberglas cloth or mat, cotton cloth, Orlon, nylon or other synthetic fibers or cloth.

Plastic Tubing Offered in Commercial Quantities

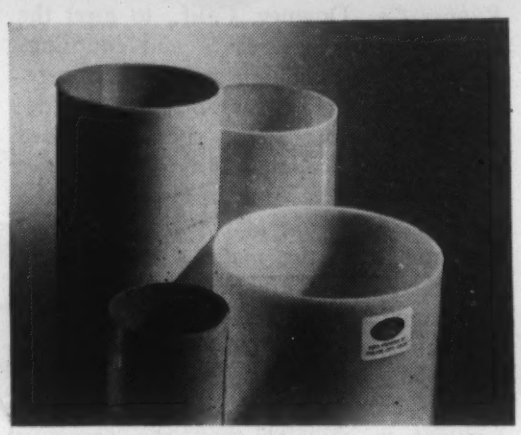
Continuous production of thermosetting plastic and Fibreglas-reinforced tubing in commercial quantities has been achieved by *Reflin Co.*, 5825 Higuera, Culver City, Calif. This accomplishment in manufacturing light-weight, strong, corrosion resistant reinforced plastic tubing in unlimited quantities is said to give engineers a new design material for vital defense applications and a substitute for presently-used materials in critical supply.

Light-weight, high strength Reflin is claimed to be ideal for housings of airborne equipment and components. Portability makes it good for fuel-dispensing lines. Other uses include standpipes and vent tubes, oil gathering lines, irrigation lines, salt-water piping, electrical conduits, sanitary piping, natural gas pipelines, and many others.

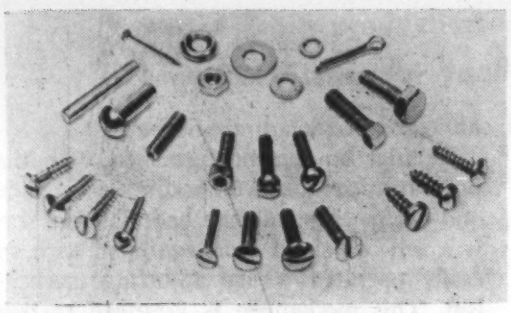
Testifying to the importance of plastic tubing in the defense effort, the Navy's Bureau of Ships is reported to have found polyester, Fibreglas-reinforced plastic pipe an ideal substitute for copper-nickel and copper-brass shipboard piping systems.

Reflin tubing is available in standard sizes from 4 to 10 in. o.d. with wall thicknesses ranging from 0.030 in. Sizes up to 36-in. o.d. are available to order. Reflin has a tensile strength up to 35,000 psi and a flexural strength up to 65,000 psi. Varying with diameter and reinforcement, burst pressures range to 3000 psi. Straight sections of 20 ft in length are coupled by cemented sleeves. With standard fittings Reflin is suitable for piping installations.

With a specific gravity of 1.50 to 1.55, the material's strength-to-weight ratio is unequalled by any commercial material. The pipe is said to be resistant to weather, soil, corrosive liquids and gases, including dilute and fatty acids, dilute alkalis, salts, aliphatic and aromatic hydrocarbons, mineral and vegetable oils, greases, alcohols and gasoline. Temperature stability assures continuous operation between temperatures ranging from —60 F to 230 F.



This thermosetting plastic and Fibreglas-reinforced tubing is light-weight, strong and corrosion resistant.



These stainless steel fastenings are available for immediate delivery.

Stainless Steel Fastenings Available in Many Varieties

Immediate delivery of large and small orders of stainless steel fastenings is currently available from *Star Stainless Screw Co.*, 190 Union Ave., Paterson 2, N. J.

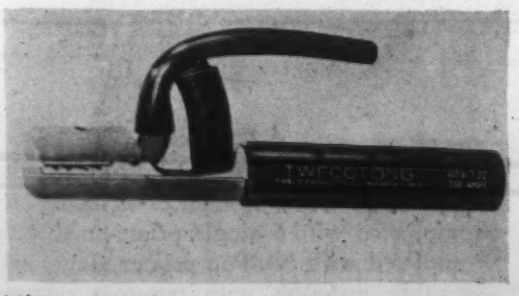
The company maintains a complete supply of stainless steel fastenings so that orders can be filled "right off the shelf" for cap screws, machine screws, sheet metal and wood set screws, nuts, washers, etc. Included in the company's standard stock are small screws in Class 3; 0/80—1/72—2/64 up to 1 in. with AN drilled heads. Special screw machine products are also available.

High Strength, High Conductivity Copper-Silver Alloy

A new high strength copper-silver bronze with high electrical conductivity is currently being produced by *Handy & Harman,* 82 Fulton St., New York 38. The alloy, containing 94 copper and 6% silver, is sold only in the heat treated and cold worked condition.

The drastic cold working of the heat treated alloy develops tensile strengths ranging from 140,000 to 165,000 psi and electrical conductivity of 70% International Annealed Copper Standard. It is produced in round wire 0.160 in. in dia. down to the fine gages of magnet wire and in flat wire of equivalent cross section area having a maximum width of ½ in.

Indicated applications are for spring parts requiring high electrical conductivity; also for watch and instrument parts which may be blanked from narrow strip. According to the company, the alloy shears cleanly, cuts freely to give a fine finish, and has sufficient ductility to withstand some forming operations.



This new electrode holder is especially designed for high-speed production, pipe welding and job shop work.

Electrode Holder Features Light Weight, High Copper Alloy

A new, light weight, 300-amp electrode holder has been introduced by *TWECO Products Co.*, P. O. Box 666, Wichita 1, Kan. Known as Model A-732, Twecotong Holder, the new product features a light weight, high copper alloy for maximum conductivity.

The holder will handle from 7/32-in. through 1/16-in. electrodes. The welding cable can be soldered or clamped mechanically to the body of the holder. Specifically designed for high-speed production, pipe welding and job shop work, the unit is 9¼ in. in length. A raised upper lever is said to allow plenty of room for the operator's band with a welding rod in the jaws. Both the body and tip ends of the electrode holder have been insulated with this company's patented Super-Mel insulators.

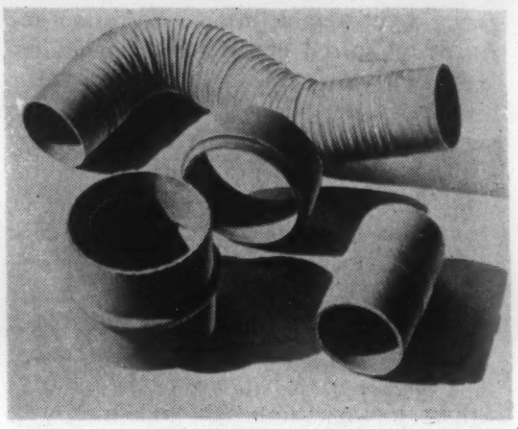
New Materials and Equipment continued

Improved Silicone-Fiber Glass Products Good at High and Low Temperatures

ArcoSil #2184 is the most recent of a line of silicone rubber impregnated fiber glass materials developed by *Arrowhead Rubber Co.*, Downey, Calif., to meet the need for ducting, sleeves and couplings with resistance to high and low temperatures. The material combines a newly developed silicone rubber compound with improved fabrication techniques which is said to result in a superior product at a lower cost. Items manufactured by the company from the material are claimed to withstand temperatures as high as 700 F; remain flexible at —125 F; resist aging, ozone and most corrosive fluids and gases. The new silicone rubber compound is also claimed to be several times more resistant to abrasion than any previous silicone rubber material.

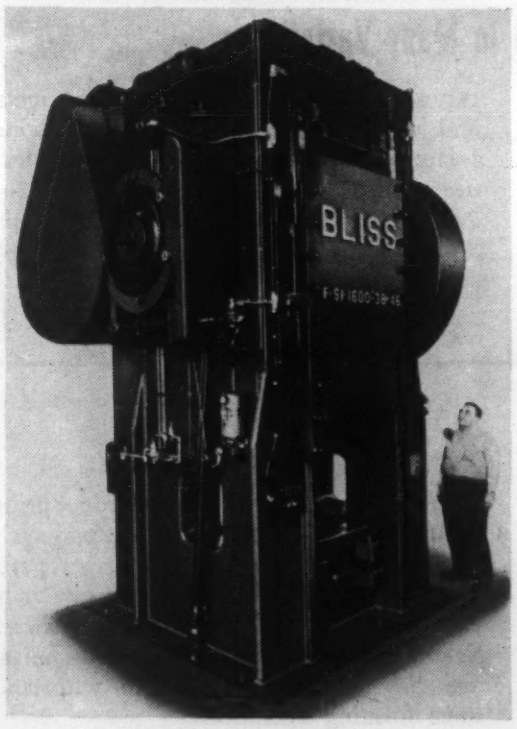
An important characteristic of the new material is that it lends itself more readily to the forming of both simple and complex shapes. This has made possible new and improved fabrication methods, which result in substantial reduction in cost of items. In addition, ducts fabricated from the material have less leakage.

Items now in production and available as standard and custom-made parts include helical wire supported flexible ducting and tubing in all diameters for high and low pressure applications, convoluted and sleeve-type flexible couplings for hot air ducts, high pressure-high temperature hose suitable for handling hot air at 700 F and 2000 psi, die-cut high temperature gaskets, and fabric-covered sponged silicone seals for high and low temperature sealing applications. The material can be bonded to metal, and parts can be fabricated with built-in T's, elbows, flanges and other special features.



These complex shapes have been fabricated from the new silicone rubber impregnated fiber glass material.

High-Speed Forging Presses Improved



This high-speed forging press is available in capacities from 300 to 4000 tons.

Development of an improved line of high-speed forging presses has been announced by *E. W. Bliss Co.*, Canton, Ohio. Available in capacities from 300 to 4000 tons, the new line features a heavy duty air friction clutch and an air release spring set brake, both mounted on a full eccentric main shaft.

The welded steel frame is designed with the main stress members located immediately adjacent to either side of the die seat and extending from the bottom of the bed to the top of the crown. These members have unusually heavy sections to keep the elongation of frame to a minimum when load is applied to press. A heavy plate, integral with the two front gibs, is bolted securely to the main stress carrying members. This plate, in addition to massive frame tying members in the rear of the press, opposes the inward deflection of frame toward the slide ways. The front of the slide has long and continuous gib ways extending up into the crown to keep the dies in alignment when off center loads are applied.

Regular equipment furnished with the press includes a cam knockout in the slide and a cam liftout in the bed. The die seat is a self-contained unit, equipped with an easily operated wedge adjusting mechanism. This mechanism is arranged so that the die seat can be bumped to the correct front-to-back alignment without disturbing the adjusting mechanism. Wedges can be inserted between the die seat and the frame uprights of the press for precision side-to-side alignment of the die seat.

To assist smooth operation at the relatively high speeds at which these presses operate, a buffer cylinder is installed in the crown which assists the brake in stopping the heavy slide at top stroke and furnishes additional accelerating force when starting the slide, easing the load on the clutch. A load indicator, which registers the actual load on the press by measuring the elongation of the frame uprights, is furnished with the press as standard equipment.

Alkali Resisting Primer Provides Increased Surface Protection

Nu-Pon, a new type alkali resisting primer which provides greatly increased surface protection and effects substantial savings in labor and material, has been announced by *Glidden Co.*, Cleveland. The primer was developed primarily for the laundry appliance industry, although new uses are now being exploited.

According to the company, two-coat finishing systems for washing machine and clothes drier exteriors employing the primer, followed by a conventional washing machine top coat enamel, are now capable of withstanding 4 to 10 times the exposure to alkaline washing solutions than has formerly been possible.

Large scale production finishing of the interiors of these appliances is being accomplished with a single prime-finish coat completed with Nu-Pon primer alone, and in other instances with two-coat systems in which the primer is top coated with an orthodox washing machine enamel.

(More News on page 144)

2 ways to ease your Steel Shortage

1 Collect all dormant Steel Scrap and get it to the steel producers

Millions of tons of valuable scrap still lie idle in America. Scrap salvage means more production—a stronger America. Clean out your plant . . . sell all your iron and steel scrap to your local scrap dealer now. The need is urgent. Every bit will help to meet the needs of defense production.

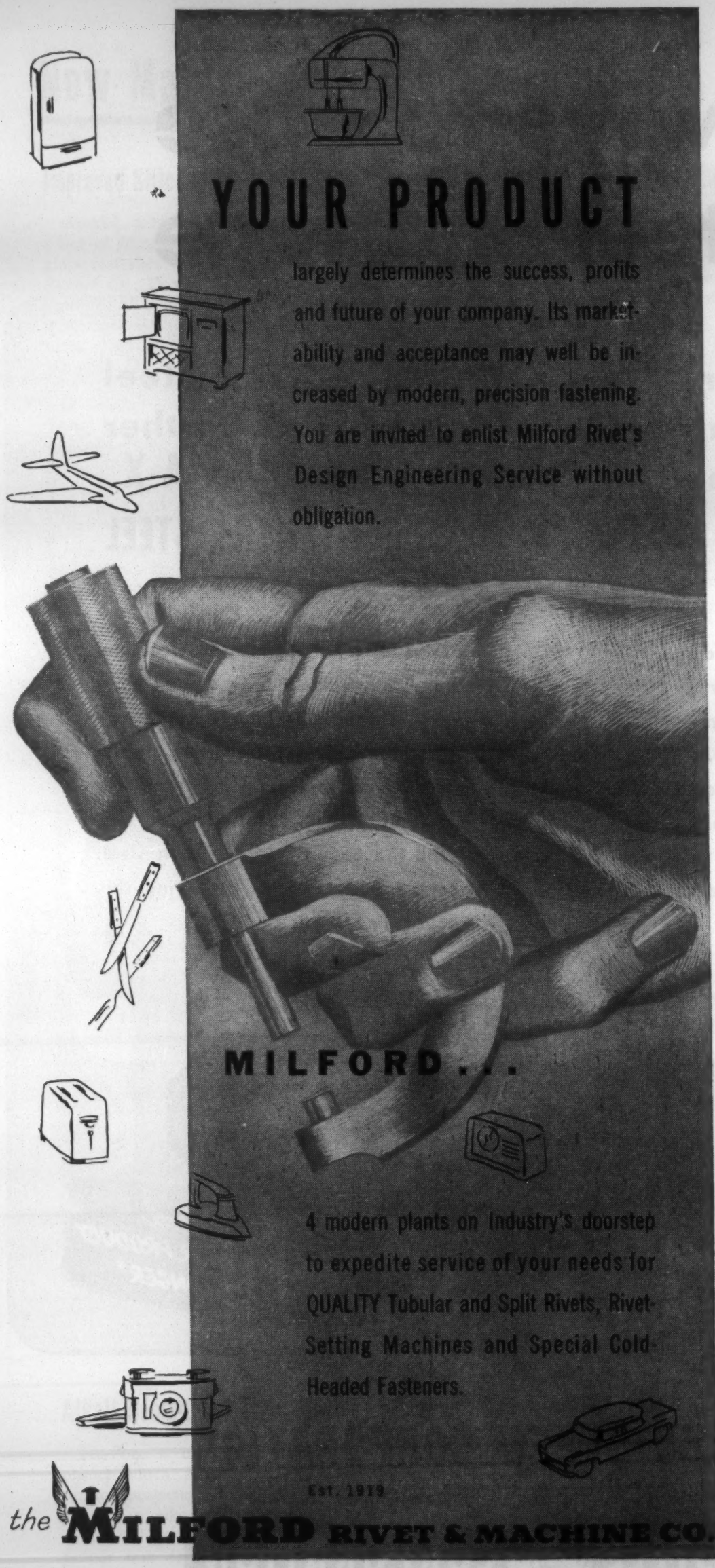
2 Make your steel supply go farther —specify N-A-X HIGH-TENSILE STEEL

Users of N-A-X HIGH-TENSILE steel find they can make 3 tons do the work of 4. Through its high strength and corrosion-resistant properties, lighter sections can be used without sacrifice of quality. It fabricates and welds with the ease of mild carbon steel. Let us assist you in applying this economy to your products.

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division — Ecorse, Detroit 29, Mich.

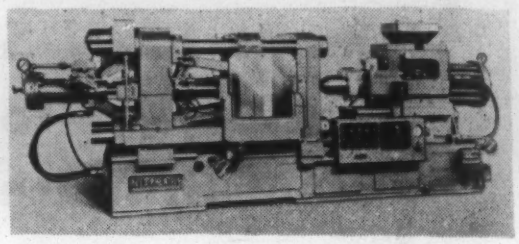
NATIONAL STEEL CORPORATION



New Materials and Equipment

Injection Molding Machine Features Tie-Bar Construction

Patterned after the larger 24-, 32- and 60-oz. plastic injection molding machines, the new 16oz. machine now offered by *Reed-Prentice Corp.*, 677 Cambridge St., Worcester 4, Mass., features rugged tie-



This 16-oz injection molding machine is said to plasticize 110 lb of thermoplastic material per hr.

bar construction offering many advantages over the former frame-type machine.

Designated the 400T model, the new machine is said to plasticize 110 lb of thermoplastic material per hour. Die platens have been increased to 35 by 40 in. to accommodate larger molds and provide a casting area of 200 sq. in. A new mold closing mechanism develops 400 tons locking pressure. Stroke is a full 16 in. and can be shortened for thin molds. A special prefill arrangement to die closing cylinder speeds up the machine cycle. Dry cycle time is 190 shots per hr.

A central control panel at the operator's fingertips which automatically controls movement of the die plate and plunger is another feature of the new unit. Movable die plate slides on four 4¾-in. dia tie bars with additional support provided by hardened steel ways to insure proper alignment.

An efficient heating cylinder, incorporating a copper core spreader, is mounted on vertical ways to permit easy removal.

New Adhesive Designed for Bulk Shipment and Storage

Uformite 400, a high-solids, aqueous urea-formaldhyde resin adhesive, which is especially designed for bulk shipment and storage, has been announced by The Resinous Products Div., *Rohm & Haas Co.*, Washington Sq., Philadelphia 5.

According to the company, Uformite, when stored at normal temperature (75 F), has a useful life of at least six months. Of particular interest to the plywood manufacturer is the viscosity stability of the resin, a factor which is said to make it un-

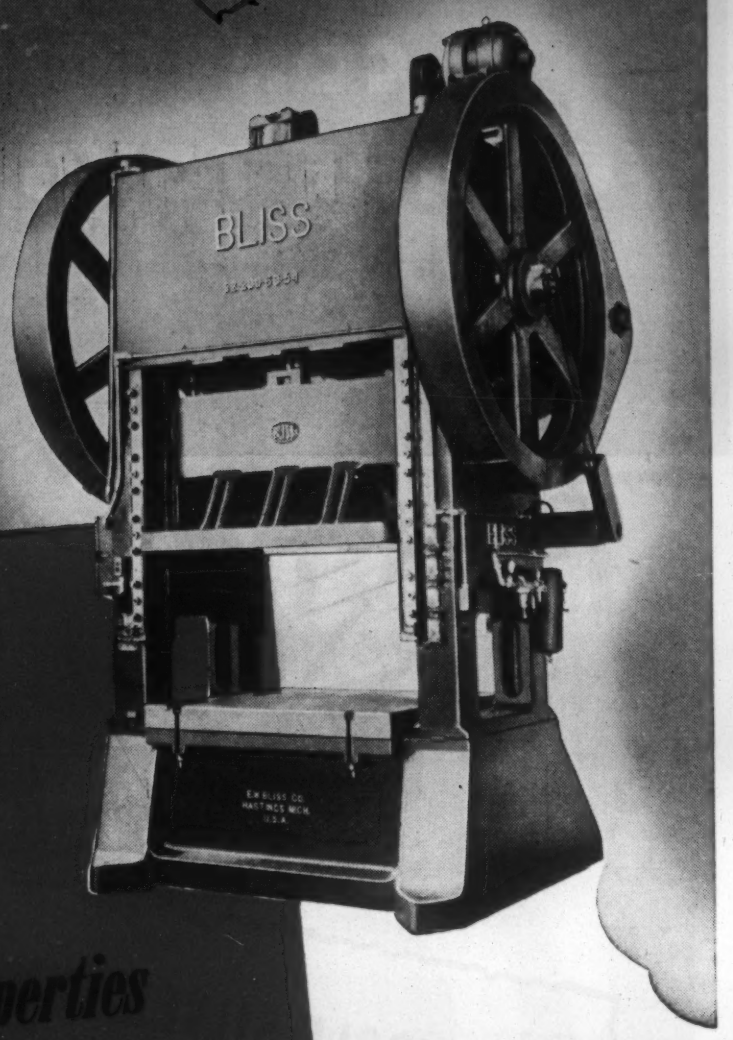
BLISS PRESSES

Famous for Sturdy Productivity

are built with

MEEHANITE® CASTINGS

Famous for Top Quality Properties



BECAUSE the production and management team of the E. W. Bliss Company, Canton, Ohio learned from experience that Meehanite castings could regularly provide the reliable range of top quality properties demanded by their specifications, they operate two foundries which produce these castings for all major component parts.

The Bliss S-2 Heavy Duty Press shown is built with the following 10 major castings:

1. *Press Bed*
2. *Crown*
3. *Connections*
4. *Uprights*
5. *Slide*
6. *Bolster Plate*
7. *Bearing Caps*
8. *Flywheel*
9. *Gibs*
10. *Gears*

As can be seen from this list, the Bliss line, noted for its rugged dependability, precision manufacture, and trouble-free service makes maximum use of the uniform dependability of Meehanite castings—castings processed to provide the right combination of properties for the job.

Today as in the past, in modern designs the "TREND IS TOWARD MEEHANITE CASTINGS." Investigate the many ways they can improve your product—production—quality.

Write for our new sound slide film "Meehanite Castings Serve All Industry."

Take *YOUR* Casting Problem To A MEEHANITE FOUNDRY

American Brake Shoe Co.	Mahwah, New Jersey
The American Laundry Machinery Co.	Rochester, New York
Atlas Foundry Co.	Detroit, Michigan
Banner Iron Works	St. Louis, Missouri
Barnett Foundry & Machine Co.	Irvington, New Jersey
E. W. Bliss Co.	Hastings, Mich. and Canton, O.
Builders Iron Foundry	Providence, Rhode Island
Compton Foundry	Compton, Calif.
Continental Gin Co.	Birmingham, Alabama
Crawford & Doherty Foundry Co.	Portland, Oregon
The Cooper-Bessemer Corp.	Mt. Vernon, Ohio and Grove City, Pa.
Empire Pattern & Foundry Co.	Tulsa, Oklahoma
Farrel-Birmingham Co., Inc.	Ansonia, Connecticut
Florence Pipe Foundry & Machine Co.	Florence, New Jersey
Fulton Foundry & Machine Co., Inc.	Cleveland, Ohio
General Foundry & Manufacturing Co.	Flint, Michigan
Greenlee Foundry Co.	Chicago, Illinois
The Hamilton Foundry & Machine Co.	Hamilton, Ohio
Hardinge Company, Inc.	New York, New York
Hardinge Manufacturing Co.	York, Pennsylvania
Johnstone Foundries, Inc.	Grove City, Pennsylvania
Kanawha Manufacturing Co.	Charleston, West Virginia
Lincoln Foundry Corp.	Los Angeles, California
E. Long Ltd.	Orillia, Ontario
Otis Elevator Co., Ltd.	Hamilton, Ontario
The Henry Perkins Co.	Bridgewater, Massachusetts
Pohlman Foundry Co., Inc.	Buffalo, New York
Rosedale Foundry & Machine Co.	Pittsburgh, Pennsylvania
Ross-Meehan Foundries	Chattanooga, Tennessee
Shenango-Penn Mold Co.	Dover, Ohio
Sonith Industries, Inc.	Indianapolis, Ind.
Standard Foundry Co.	Worcester, Massachusetts
The Stearns-Roger Manufacturing Co.	Denver, Colorado
Traylor Engineering & Mfg. Co.	Allentown, Pennsylvania
Valley Iron Works, Inc.	St. Paul, Minnesota
Warren Foundry & Pipe Corporation	Phillipsburg, New Jersey

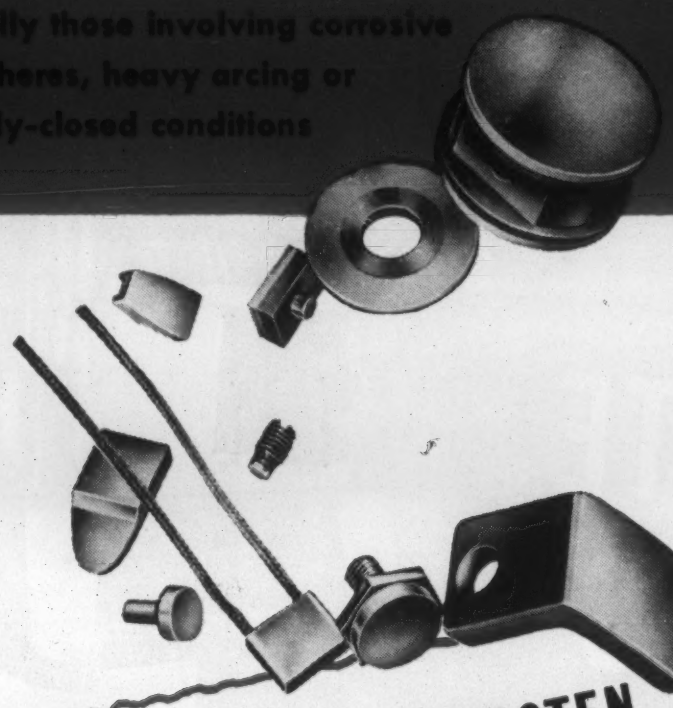
"This advertisement sponsored by foundries listed above."

MEEHANITE®

NEW ROCHELLE, NEW YORK

CONTACTS FOR THE TOUGH JOBS

especially those involving corrosive atmospheres, heavy arcing or normally-closed conditions



STACKPOLE SILVER-TUNGSTEN..

for Circuit Breakers • Motor Controllers
Transformer Protective Units • Aviation Relays
Contactors . . . and similar equipment

For a wealth of contact data, write on company stationery for Stackpole Contact Booklet 12. (Stackpole contacts are sold only to makers of original equipment.)

When heavy-arcing, corrosive atmospheres or the rigors of normally-closed operating conditions greatly reduce contact efficiency and life—use Stackpole Silver-Tungsten! The outstanding strength, density and conductivity of these unique contacts have assured materially longer, trouble-free service on a long list of products. On a typical circuit breaker application, Stackpole silver-tungsten contacts increased the interruption capacity from 10,000 to 15,000 amperes *while making possible a decrease in the physical size of the unit!*

Only a few standard grades are available. Best results are obtained by letting Stackpole contact specialists develop a suitable silver-tungsten combination for your specific equipment.

STACKPOLE

STACKPOLE CARBON COMPANY, St. Marys, Pa.

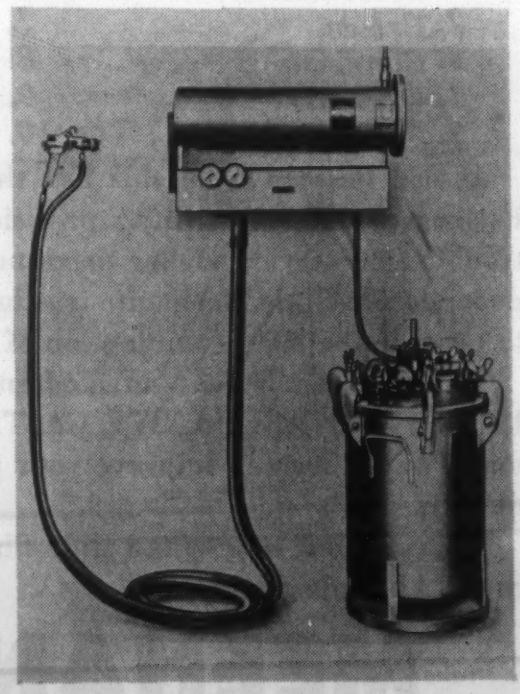
New Materials and Equipment

necessary to adjust glue formulations frequently. Further, the viscosity-solids balance of the product makes the resin adaptable to hot press, cold bonding, lumber-core gluing by clamp-carrier or high frequency, reaggregated wood bonding, and other specialty applications.

Pumpless Hot Spray Unit Holds Temperature, Pressure Constant

The superior finishes obtainable by hot spray painting are now available to a wide range of industries through the introduction of an improved unit which is said to eliminate paint circulating pumps and other moving mechanical parts. The device, which can be used with any standard paint spray system, is being placed on the market by *Special Equipment Corp.*, 225 Lafayette St., New York 12.

Called Thermo-O-Spray, it is based on the principle that the ideal method of applying hot coatings is to heat a small quantity of paint for a short period of time under constant temperature and pressure just before spraying. This is accomplished by the unit without the use of complicated circulating pumps or troublesome mechanical contrivance. There are no moving parts to get out of order, and no electricity is used in the paint heater. Circulating hot air keeps paint in both paint hose and heat exchanger at constant temperature even during interruptions in spraying. The construction of the heater



This hot spray unit eliminates paint circulating pumps and other moving mechanical parts.

Quality controlled Arwood precision castings

When your product needs peak casting performance, take advantage of Arwood's Quality Control.

A typical Arwood Casting for aircraft use is illustrated—tolerances of ±.005 and rigid aircraft specifications are maintained.

Steel die molds assure accurate dimensions and sharp serrations.

Metal soundness is assured by X-ray and Magnaflux controls, physical and chemical certifications.

Arwood Precision Investment Casting is now a tested and important method for producing small intricate parts. It has been the answer to many design and production problems and can be the answer to yours.

For additional information about Precision Castings write Dept. 201 for our new booklet, "Alloy Selection and Design for Investment Castings."

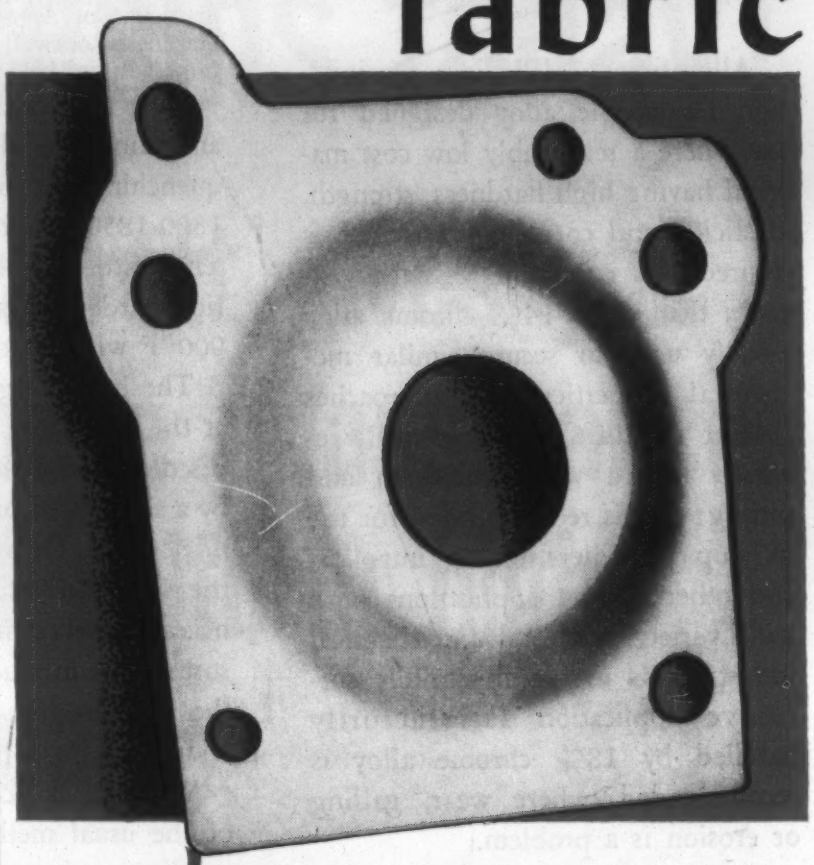
ARWOOD

PRECISION CASTING CORP.

74 WASHINGTON STREET • BROOKLYN 1, N. Y.

Plants: Brooklyn, N. Y., Groton, Conn., Tilton, N. H.

Announcing Cohrlastic diaphragm fabric



Orlon silicone coated

from −100° to +300°F

write for samples and data

For the first time, Orlon*, the new industrial fabric, is now coated with silicone rubber to produce a new type of diaphragm material.

Cohrlastic 3500 is highly resistant to heat up to +300 and cold down to —100°F. It is impermeable, has excellent aging and dielectric properties, high tensile strength and outstanding flex resistance. It is an ideal diaphragm fabric for any application that must face severe temperature conditions.

Cohrlastic 3500 comes in rolls 36" wide and various thicknesses. It may be readily cut to any desired size or may be purchased in the form of completed diaphragms, either flat or convoluted.

*TM DUPONT

THE Connecticut HARD RUBBER COMPANY

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TECHNICAL TOPICS

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Norman S. Mott

Chief Chemist and Metallurgist

Alloy type 17-4PH is a precipitation hardenable alloy designed for use where a reasonably low cost material having high hardness, strength, elasticity, and corrosion resistance is desired. Its corrosion resistance exceeds that of 12-14% chrome alloy usually used to secure similar mechanical properties, and approaches that of 18 and 8. It is especially resistant to sea water corrosion and pitting; and is recommended for use in ship propellers, pump impellers and other marine applications of a wide variety. In food and chemical industries its use in any mildly corrosive application satisfactorily handled by 18% chrome alloy is recommended, where wear, galling or erosion is a problem.

It is readily machinable in the solution annealed condition, and when hardened, has in addition to the excellent mechanical properties of strength and elasticity, an appreciable amount of ductility and toughness.

The typical chemical composition is: C 0.05; Cr 16.5; Ni 4.0; and Cu 4.0 per cent. Mechanical property values in castings are:

	as solution annealed	as precipitation hardened
Tensile Strength PSI	152,000	179,000
Yield Point PSI	83,000	150,000
Elongation %	5%	4%
Reduction of Area %	8%	7%
Hardness-Rockwell "C"	34	41
Impact-Resis. Izod	27	17

Heat treatment consists of solution annealing the alloy by water or oil quenching, or by air cooling from 1800-1850°F after one-half hour at temperature, followed by precipitation hardening for one hour at 850-900°F with air cooling.

The hardening treatment produces at the most only a light heat tinting discoloration which is easily removed by a short light pickle in warm dilute nitric acid. Of special importance is the fact that stress relieving is unnecessary since no cracking of any sort is ever produced, as is sometimes the case in the hardenable chrome alloys.

Welding is accomplished by any of the usual methods using 17-4PH welding rod and no intergranular corrosion embrittlement results from the welding heat effect. If fully hardened material is welded, a hardening treatment of 900°F will bring the properties of the weld joint close to those of the parent metal.

Close consideration of this alloy shows that it fills a much needed gap in the range from high mechanical properties to good corrosion resistance in the low cost alloy field.

* Developed by Armco Steel Corporation.

Copies of this article reprinted on heavy stock for convenient filing are available on request.

The **COOPER ALLOY** Foundry Co., Hillside, N.J.

New Materials and Equipment

is such that color changes or cleaning is easily accomplished in a few minutes.

Filtered, moisture-free air is passed through a thermostat-regulated, explosion-proof electric air heater, where it is heated to a temperture between 300 and 400 F. This super-heated air then passes through the heat exchanger and heats the paint or lacquer up to the temperature recommended for the application. In the heat exchanging process, the air is reduced to about 85 F, which is considered the optimum temperature for atomizing, and it is immediately passed on to the spray gun for atomization of the hot paint.

The Unit consumes 1400 watts, and is ready for use within 15 min. after applying the current. It has a capacity of 25 to 30 oz per min., which corresponds to the maximum capacity of modern spray guns.

New Cutting Carbide Good for Old or Slow Speed Machines

A new grade of cutting carbide has been developed by *Newcomer Products, Inc.*, Latrobe, Pa. Known as Grade S-6, the carbide has been tested and used in industry for approximately a year and a half, and is said to have proven to be highly efficient where the nature of the job makes slow speeds necessary.

Even though S-6 can be used at high machining speeds, its greatest tool life is obtained at speeds slower than those at which other grades of carbide can be successfully used. S-6 is, therefore, especially suitable for use on old or slow speed machines.

According to the company, the carbide is excellent for interrupted cuts. It removes stock fast because of the heavy feeds permissible. Several large producers of Army tank parts have found S-6 does an outstanding job when machining Armor Plate, rough steel forgings and castings.

Self Lubricating Wear Plates Suitable for Many Uses

A recent development in powder metallurgy by the *Michigan Powered Metal Products Co., Inc.*, Northville, Mich., is the unique "stored lubricant" wear plate. The all-metal wear plate is a single piece containing a large internal cavity filled with

The No. 1 Fact in Phenolic Resins today!

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1. The raw materials — **In the required raw materials,** Barrett has a basic position because Barrett is a basic producer.

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powder, chip, lump, laminating varnishes and bonding solutions—

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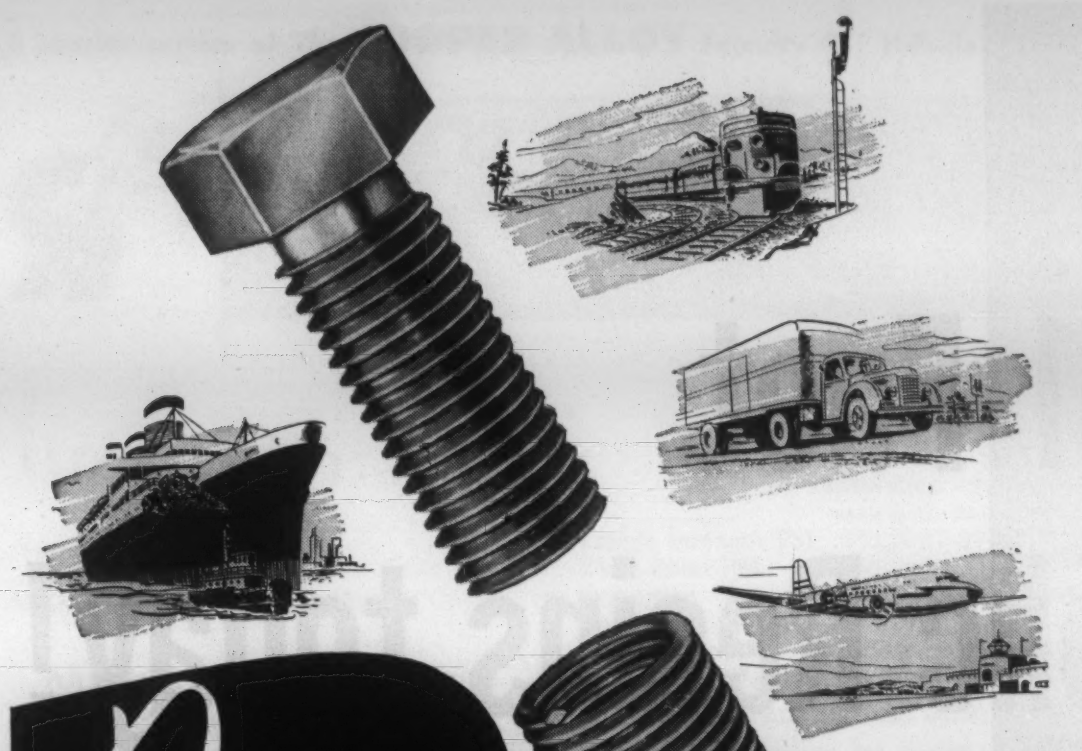

Design to eliminate wear and tear in threaded assemblies

Product designers who specify *Heli-Coil** Screw Thread Inserts for threaded assemblies get full protection against wear and tear, particularly in light metals. These inserts add vital strength to all tapped threads . . . prevent stripping from high torque or tension; prevent corrosion, galling and seizing . . . and they *completely* eliminate thread wear caused by repeated disassembly and re-assembly.

The strength of stainless steel *Heli-Coil* internal threads in light metals permits simpler, more functional design. With the *Heli-Coil* System, you can design with fewer and smaller studs or capscrews and shorter thread engagements, and yet obtain the required holding power. The results—less weight, less bulk and lower cost. Incorporate *Heli-Coil* Inserts into your next design.

Heli-Coil Inserts meet all industrial and military specifications for National Coarse, National Fine and Unified Threads . . . and for spark plug and pipe threads. Available for Classes 3, 3B, 2 and 2B fits in all popular sizes from 4-40 to 1½-6.

*Reg. U.S. Pat. Off.

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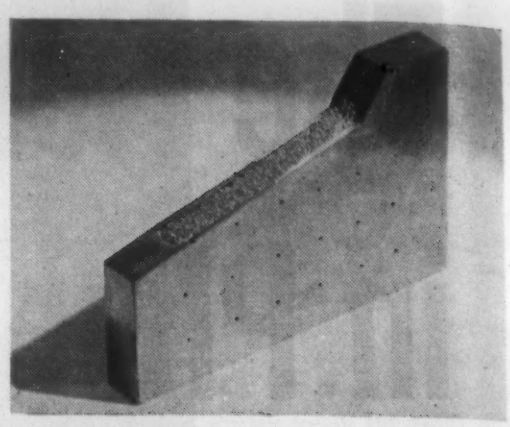
New Materials and Equipment



This stored lubricant wear plate contains a porous, yet rigid metal sponge containing lubricant.

an extremely porous, yet rigid metal sponge containing lubricant.

This completely enclosed metal sponge distributes lubricant to either surface of the plate through pores in the wall of the cavity. Pre-determined passages can be arranged in any configuration to meet the requirements of any application.

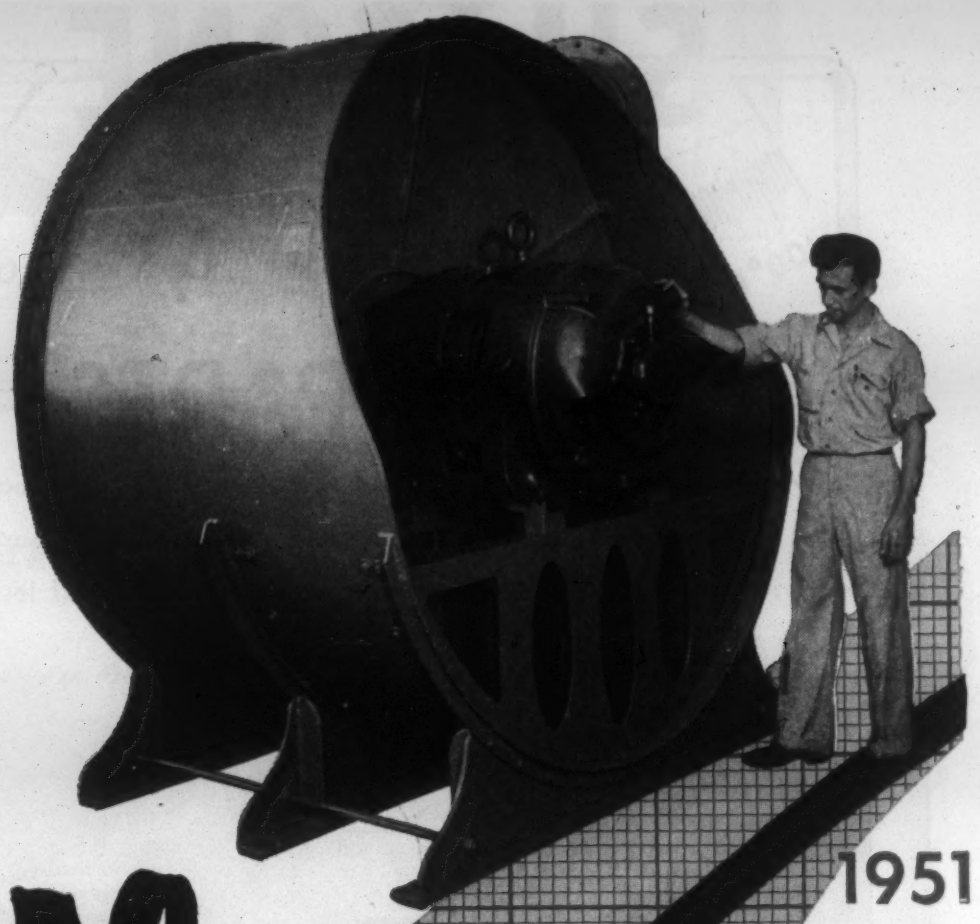
Each plate contains its own fresh supply of lubricant in the capillaries of the sponge in addition to the normal supply within the pores of the wall structure. This increased lubricant supply is drawn on according to need by controlling the size and distribution of uniform surface connected pores. The metal sponge also serves to keep the lubricant adjacent to the surface connected pores by capillary action and, at the same time, prevents collapse of the lubricant cavity under extreme pressures. Hardness and other properties of the plate surface can be varied to suit the application.

Polyethylene Welded Pipe Fittings Resist Corrosive Chemicals

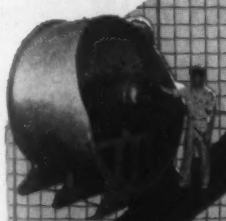
Agilene (polyethylene) flanged pipe fittings, such as tees, crosses, 45- and 90-deg elbows, up to 6-in. nominal pipe size made of polyethylene and of fully welded construction, are now being furnished by *American Agile Corp.*, P.O. Box 168, Bedford Ohio. The fittings are said to be resistant to most corrosive chemicals and are finding an ever increasing number of applications in various industries. In addition to their use in chemical pipe lines, sewage and waste installations, they are employed in transmission lines for foods and in drinking water and irrigation systems.

The fittings are made to standard dimensions of the American Standard Class 125 Cast Iron Flanged Fitting, and can

A TEN-FOLD *Increase* IN TEN YEARS



1941 H. P.



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TURBO-COMPRESSORS

The horsepower of Spencer Turbo-Compressors installed annually has increased tenfold in as many years. The simplicity of design and dependability of the all-metal Spencer with wide clearances and ball bearings is responsible for impressive repeat orders. More than 30 furnace and oven manufacturers prefer Spencer for their equipment. And a widening of the applications for blowing, cleaning, cooling and drying with high volume, low pressure air has accounted for many new installations.

Are you familiar with the many ways air is being used in industry? The how, when, and where of compressed air is described in the new Spencer Data Books No. 107-C and 126-A. Ask for your copies now.

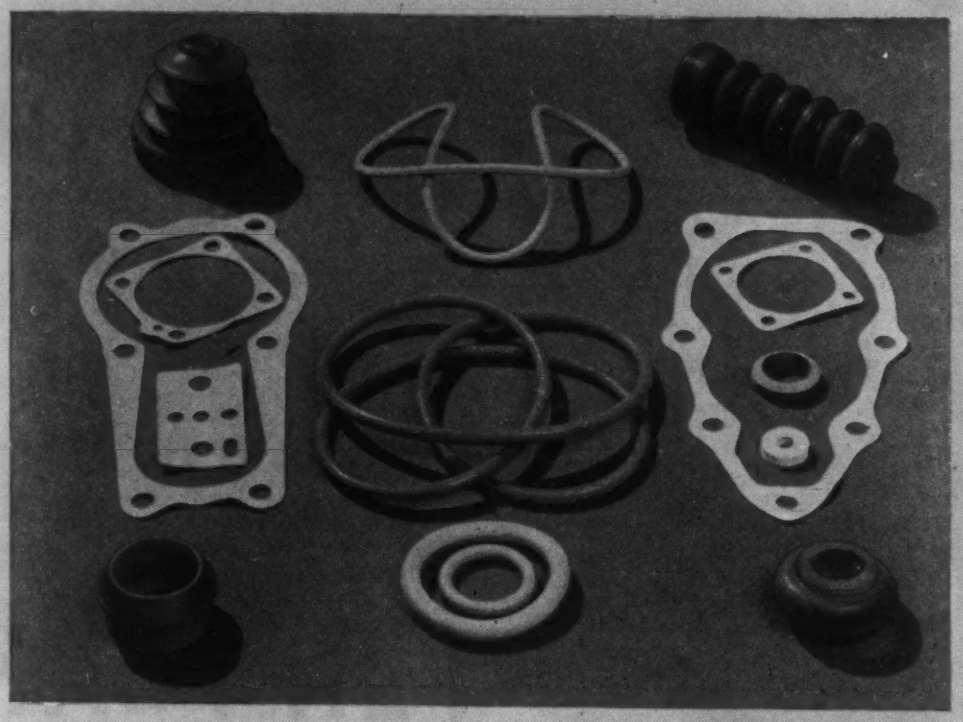
THE SPENCER TURBINE COMPANY • HARTFORD 6, CONNECTICUT

SPENCER HARTFORD

SILICONE

RUBBER PARTS

With new compounds being developed almost weekly by manufacturers of basic polymers, today's Silicone rubber molded parts are performing faultlessly in vital applications where Silicone of less than a year ago could not be considered.



Remaining resilient at extreme temperatures (−100°F to +500F°) today's Silicone stocks have greatly increased tensile strength, far better compression set results, and other vastly improved properties such as — excellent stability after long exposure to ultra-violet rays, prolonged weathering, fungus growth, many oils and a variety of chemicals. They also have excellent dielectic properties and water repellency. They bond well to metal, and are stainless and odorless.

Acushnet's Silicone rubber seals, gaskets, "O" rings, packings, diaphragms and numerous other parts are custom engineered to meet the toughest specifications.

Acushnet
PROCESS COMPANY

Send for the Acushnet Rubber Handbook, a comprehensive rubber data reference.

Address all communications to 750 Belleville Ave., New Bedford, Mass.

New Materials and Equipment

be incorporated into existing pipe lines. It is recommended that they be used with split sheet metal back-up flanges to avoid deformation of the flanges through bolt pressure.

Their extremely light weight permits easy installation, and their excellent corrosion resistance is said to guarantee a minimum of maintenance and replacement costs.

General-Purpose Electric Insulating Varnish

A new all-purpose electric insulating varnish has been developed by the Chemical Div., *General Electric Co.*, Pittsfield, Mass., which is suggested for use on a wide variety of electric equipment. It is said to be suitable for treating motor and generator cores and windings, magnet coils, and transformer windings. It can be used on rotors with speeds up to 10,000 rpm.

An oil-modified phenolic varnish, 9700 cures thoroughly in deep sections giving high bonding strength with a smooth, wrinkle- and bubble-free surface. G-E 9700 can be applied by dipping, roller coating, brushing or spraying, and vacuum or pressure impregnation can be employed. Containing 49 to 51% solids, the varnish can be thinned with petroleum spirits.

Hole Punching Units for Mild Steel Up to ¾-In. Thick

New Wales Type "HS" Hydra-Strip hole punching units for punching holes in mild steel up to ¾ in. thick have been announced by *Wales-Strippit Corp.*, 345 Payne Ave., North Tonawanda, N. Y.

The heart of these new, extra-heavy-duty units is the Wales Hydra-Spring, which provides many times more stripping pressure than mechanical springs of the same volume. Such performance is the result of utilizing the compressibility of special fluids. The loads can be changed by a simple adjustment to increase or decrease the volume of the fluid.

The new units are independent and self-contained. All component parts are built into the holders which keep the round

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ELECTRODES MADE
. . . ANYWHERE

PRODUCTION MAGIC!

Where would American production be without Welding?

The planes, tanks, and ships . . . the petroleum that powers and warms a nation . . . the periodicals you read and the paper you write on . . . the railroads that span our country . . . the equipment that builds our roads, mines our coal, iron, and minerals . . . the clothes you wear . . . even the food you eat and milk you drink . . . these and the machinery that produces them **all depend on welding.** An arc welded alloy product is a better product. And **Alloy Rods** alloy arc welding electrodes in the familiar red metal containers are the **best** the world affords.

Alloy Rods Co.

AR-6

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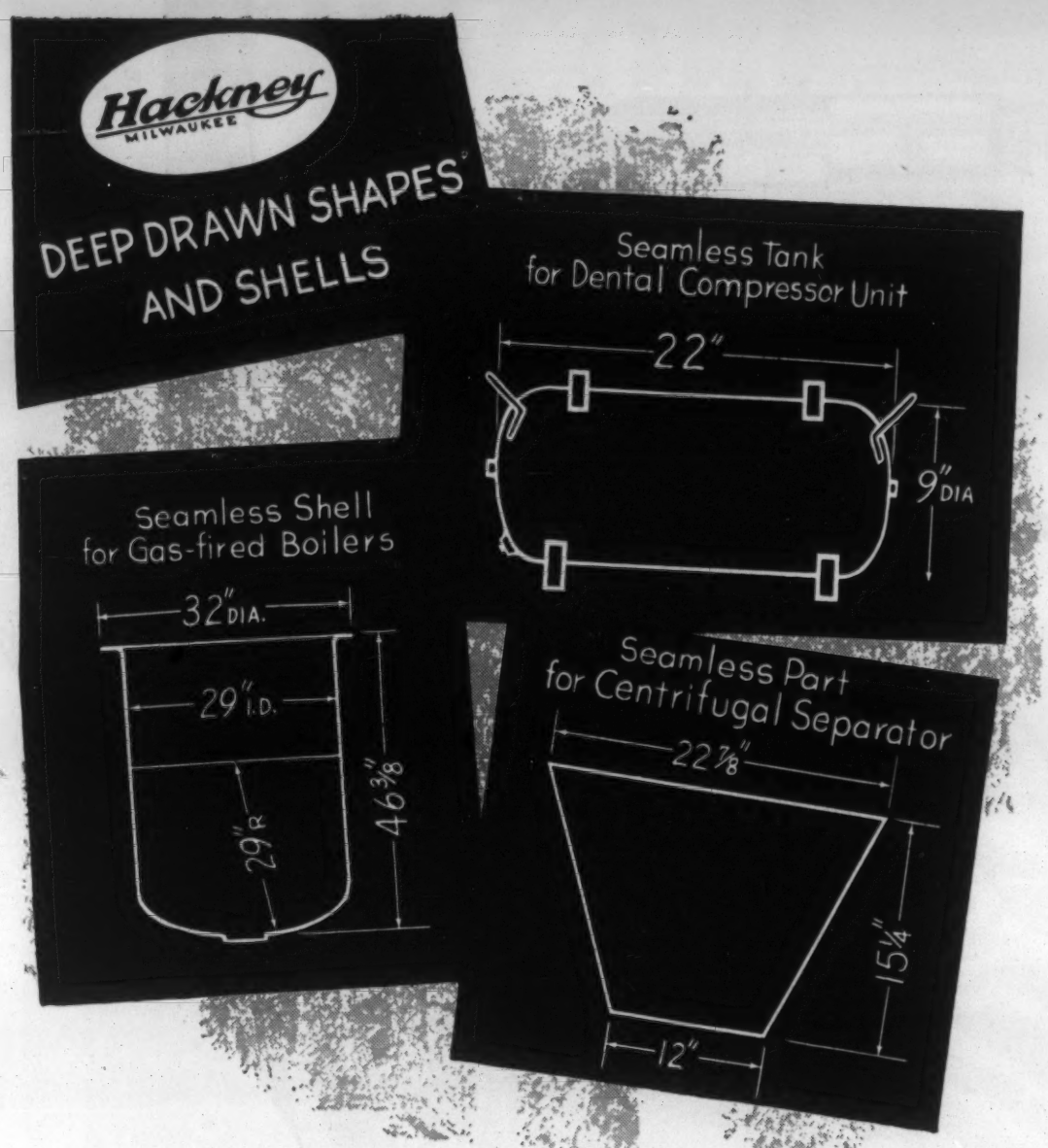
ARCALOY for stainless steel • **ARMORARC** for armor welding • **BRONZE-ARC** for bronze and cast iron • **NICKEL-ARC** for cast iron • **TOOL-ARC** for tool steel • **WEAR-ARC** for hard-facing • **WELD-ARC** for low hydrogen electrodes. **Write for specific bulletins, or consult your Alloy Rods distributor.**



These Plans
may figure in your future

You and your product may share a better future when a Hackney Deep Drawn Part replaces a casting or forging in your product.

The Hackney Deep Drawing Process assures stronger shapes and shells because they're shaped under pressure from one piece of sheet metal . . . lighter weight parts because cold drawn metal does the work of heavy forgings and castings . . . and they're faster to produce because time-consuming machining and welding operations are eliminated.

Pressed Steel Tank Company, manufacturer of Hackney Products, has almost 50 years of specialized experience in deep drawing shapes and shells for many manufacturers in many industries. These Hackney Products are made in a wide variety of metals and alloys . . . in a capacity range from 1 quart to 110 gallons . . . inside diameters from approximately 3 inches to 32 inches.

See if Hackney engineers can help you adapt special shapes to improve existing products or to develop new products. Send us a drawing of your requirements today.

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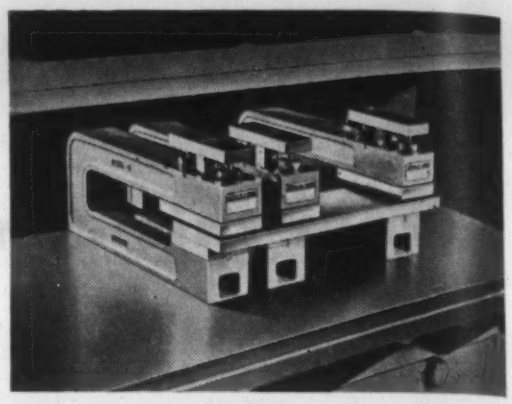
CONTAINERS FOR GASES, LIQUIDS AND SOLIDS

New Materials and Equipment



Here is a setup of the units with work on top of dies ready to be punched. Note that nothing is attached to press ram.

or shaped punches and dies in perfect alignment for the life of the units. Unlike conventional dies nothing is attached to the press ram. The only function of the ram is to depress the punch.

Setting up these units is said to be a simple, quick assembly operation—they are ready to start punching with the first stroke of the press ram without adjusting units, punches or dies.

The same group of units can be set up on templates or T-slotted plates in stamping presses and on rails, strip templates or T-slotted plates in press brakes. This interchangeable use of the same group of units is said to permit setups of unlimited hole punching patterns and fabricating parts the same day a hole punching design is released for production.

New Industrial X-Ray Films Offered

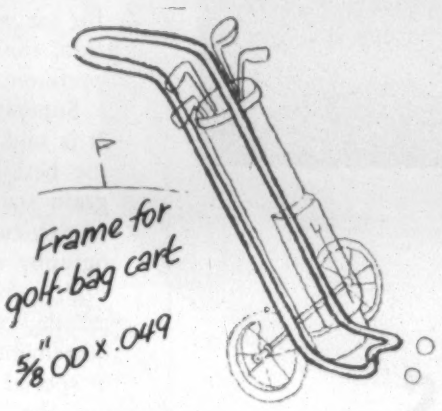
In recognition of the increasingly important role of radiography in industry for nondestructive testing, diffraction analysis and similar applications, *Ansco*, Binghamton, N. Y., a division of General Aniline & Film Corp., is offering a complete family of industrial x-ray films. According to the company, these films will meet the diversified needs of the industrial and scientific radiographer, and can be used with low or high KV x-ray exposures or with radium or cobalt gamma radiation, and can be relied upon to give brilliant radiographs of high diagnostic quality.

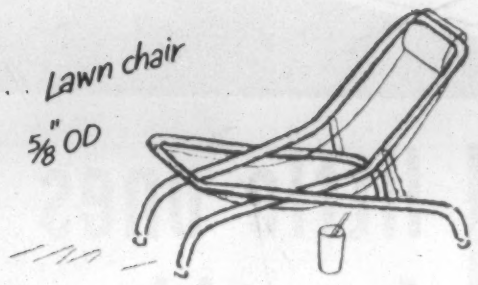
The complete Ansco x-ray industrial film line is designated as follows: Ansco Superay "A", Superay "B", Superay "C" (a non-screen type), and High Speed.

Ansco Superay "A", which has been on the market for several years, now features an improved surface, a tougher, smoother overcoating to withstand the rigors of industrial use, thus minimizing abrasion,

Bundyweld "Doodles"

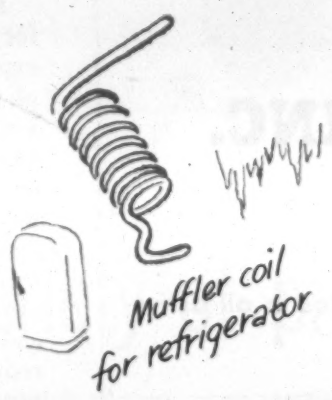
to jog a designer's imagination





Put Bundyweld Tubing into that part of yours and get improved performance. Put Bundyweld through your production lines and get lowered fabrication costs.

If you need design or fabrication help, depend on Bundy skills, the industry's finest, to save you time, materials, money. If you choose, have Bundy fabricate and ship your parts—in any quantity and on time. Write for catalog today.
Bundy Tubing Company, Detroit 14, Michigan.



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DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile
Lightweight
Machines easily
Takes plastic coating
Scale-free
Bright and clean
No inside bead
Uniform I.D., O.D.

WH-Y BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

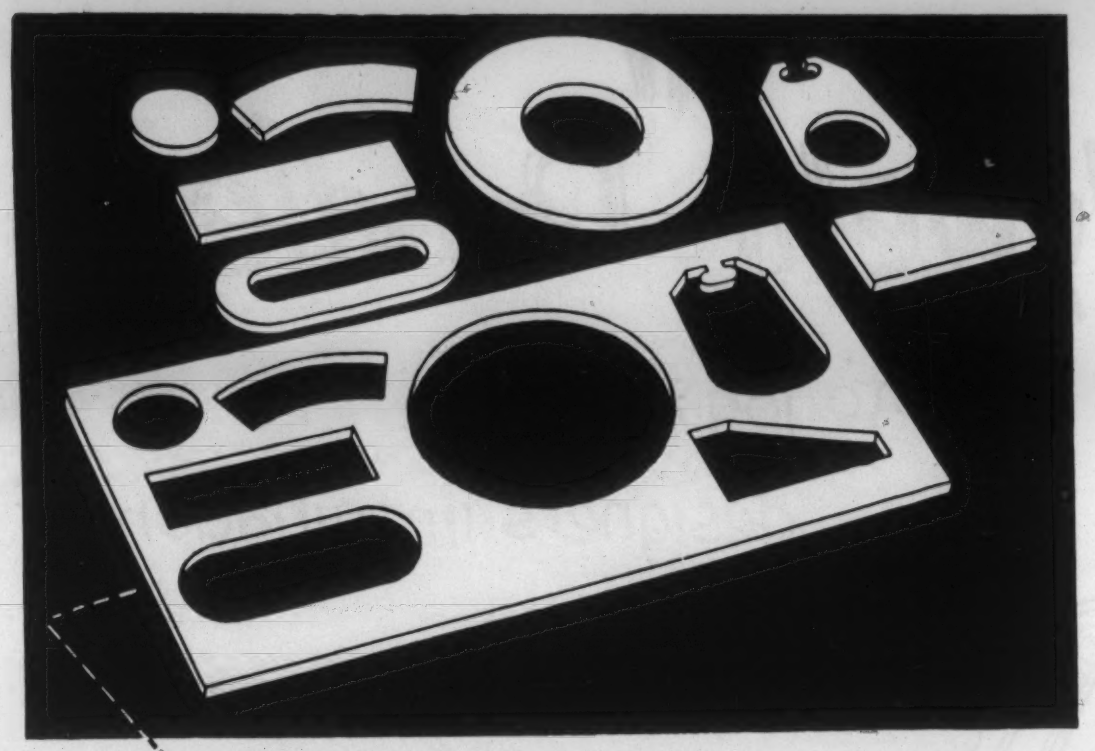
continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Copper coating fuses with steel. Presto . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: ***Cambridge, 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave. South ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 881 Bay St. • **Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.**



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from big ones
in Stainless

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Take advantage of the large stock of Stainless Steel plates in all active grades available at G. O. Carlson, Inc.

With our specialized cutting equipment we produce to your requirements: rings, diameters, irregular shapes, small plates, and head blanks—in many analyses of stainless steel—in any size—to chemical industry standards of quality.

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Warehouse distributors in principal cities

New Materials and Equipment

smudging and contamination. It is said to be ideally suited for industrial uses where the recording of small defects and fine structural detail is essential.

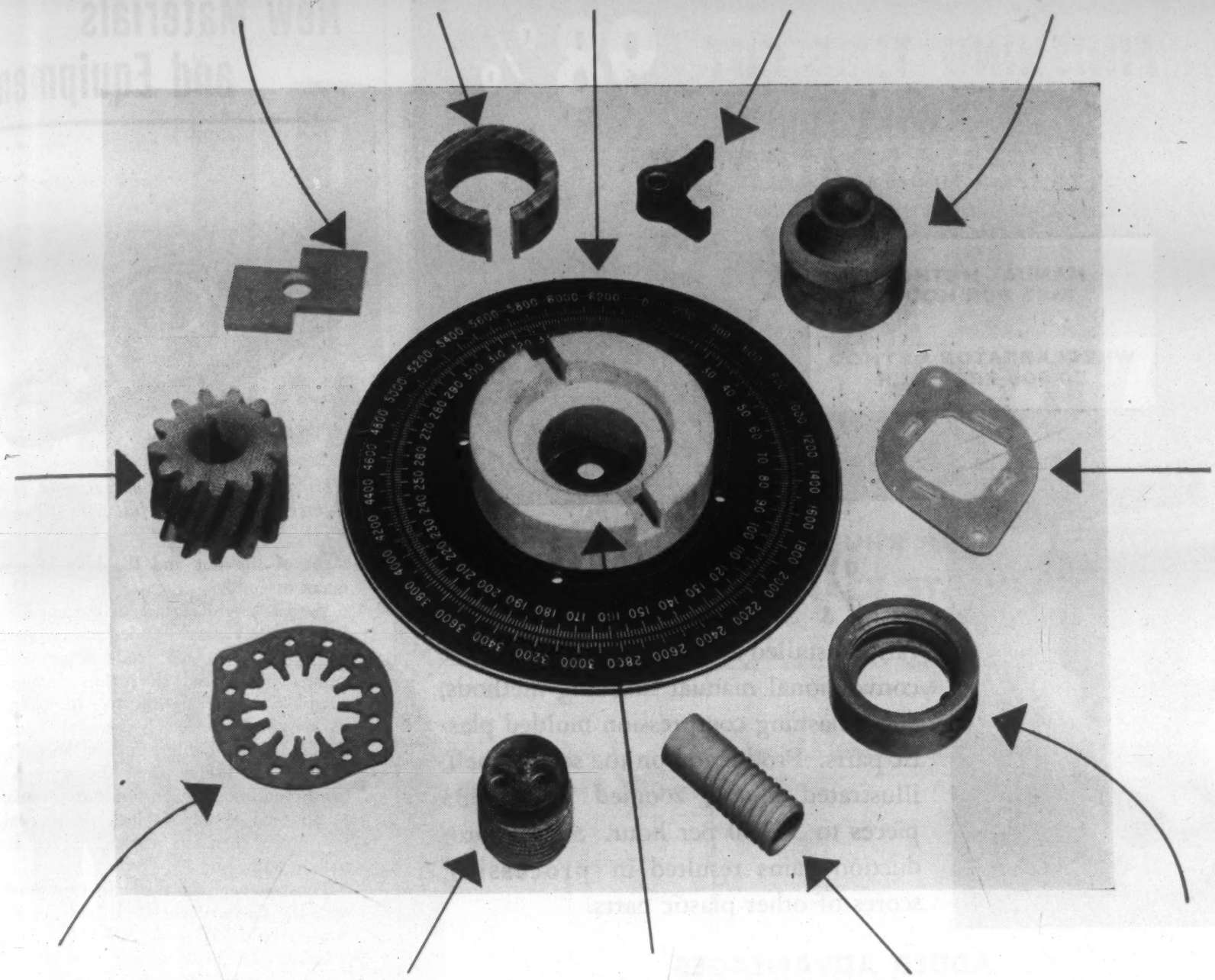
Superay "B", re-introduced for the first time since before World War II, has the finest grain and highest contrast of any film in the line. It is especially designed for use when optimum radiographic definition, sharpness and contrast are desired in preference to speed of recording.

Superay "C" is a new non-screen film. It is said to provide maximum speed with the best practical balance in contrast and grain size when used without screens. It is particularly adapted for industrial radiography where rapid exposure, moderately high contrast and good detail are demanded to satisfy routine inspection requirements. The speed of this film offers a special advantage in gamma-ray radiography. It will find wide application in the examination of heavy castings, forgings and weldments if minimum exposure times are of great importance.

High Speed x-ray film is recommended for those industrial applications where (a) exposures are normally made with screens of the calcium tungstate type; (b) where x-ray equipment of limited output is employed and material to be x-rayed is of excessive thickness. It is ideally suited for use in mass radiography of light metal castings of moderate thickness utilizing moderate voltage techniques. Used with screens, this film has excellent resolution and wide latitude, and will faithfully record detail over a considerable range of material thicknesses. It can be exposed and developed to relatively high photographic densities, and the light-blue tint of the safety base enhances inspection on standard illuminators.

Floating Anchor Nut Good at High Temperatures

A new light-weight, self-locking nut is now available in a floating anchor nut type, according to a recent announcement made by *Kaynar Co., Inc.*, 820 E. 16th St., Los Angeles. The nut, consisting of an assembly of two parts—a threaded nut portion and a retaining shell—provides a 1/16-in. radial movement between the nut and the anchoring portion. Both parts are formed of light gage annealed spring steel, and are spring tempered to provide an exceptionally light-weight, yet rigid and strong fastening device. The float (a lateral movement between the nut and the anchored retaining shell) facilitates align-



solving a variety of problems in many industries

Lamicoid®

Today, more and more manufacturers whose products call for specific properties are solving their problems with LAMICOID... a thermosetting plastic laminate. Because LAMICOID utilizes fillers of glass, nylon, fabric or paper with various synthetic resins, this versatile material can be produced with just the property or combination of properties you need.

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Can you use a material which is easily machined or punched, tough and rigid, light weight, corrosion resistant, with high impact strength, low moisture absorption, and high heat resistance?

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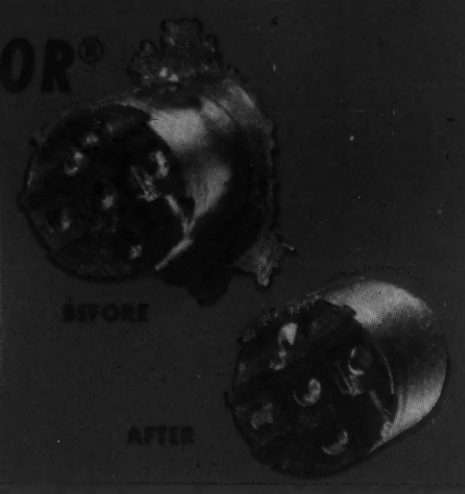
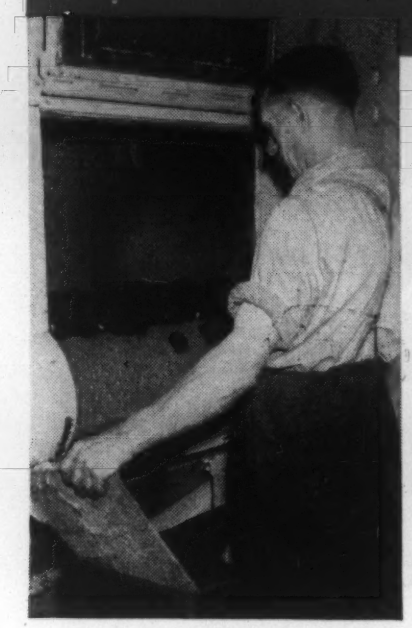
EINISHING TIME CUT 98% with WHEELABRATOR®

MANUAL METHOD
1333 PER HOUR

WHEELABRATOR METHOD
50,000 PER HOUR





at SMITH & STONE LTD.

Smith & Stone Ltd., Georgetown, Ontario, installed a Wheelabrator to replace conventional manual finishing methods, for deflashing compression molded plastic parts. Production on the socket shell, illustrated above, zoomed from 1333 pieces to 50,000 per hour. Similar production gains resulted in processing scores of other plastic parts.

ADDED ADVANTAGES

1 2 3 4

Uniform deflashing for better quality
Decreased use of costly broaches
Handles more than 50% of all production
Savings pay for machine in less than a year

THE WHEELABRATOR DEFLASHER

Wheelabrating—an exclusive American process—removes flash by pelting the parts with millions of small, nonabrasive particles capable of reaching into the most inaccessible places without any damage whatever to the part. More than 50 Wheelabrators are already in service in the Plastics industry.

If high finishing costs are a problem for you, investigate the cost-cutting possibilities of the Wheelabrator process through a demonstration in our factory laboratory. No obligation, of course. Arrangements can be made to suit your convenience.

Bulletin No. 674 contains complete information and factual case histories on the time and cost saving performance of the Wheelabrator. *Write for your free copy.*

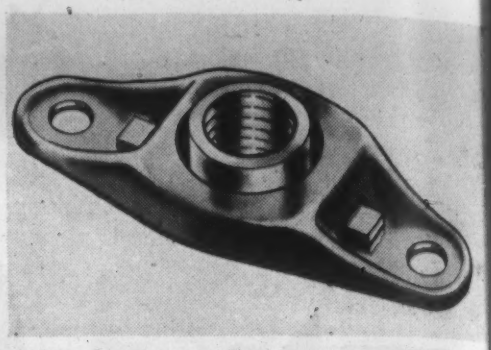
American

AMERICAN WHEELABRATOR & EQUIPMENT CORP.,

538 S. Byrkit St., Mishawaka, Indiana

WHEELABRATOR® MECHANICAL DEFLASHER

New Materials and Equipment



This floating anchor nut is said to be lighter than any other full strength anchor nut.

ment of the nut and the bolt in subsequent assembly.

An important feature of the nut is that in its plan view it is identical in outline and size to standard fixed anchor nuts of comparable thread size, thus permitting complete interchangeability. In addition, its weight is extremely low, an unusual feature since all other floating anchor nut weights are higher than the weights of corresponding fixed anchor nut variations, as opposed to the Kaylock design which is lighter than its corresponding fixed anchor nut.

The fasteners are made in conformance with the Government Lock Nut Specifications AN-N-10a and AN-N-5b. Their cadmium-plated, all spring steel construction is said to allow their use to 550 F, and because they are spring tempered and harder than any bolt threads, they are impossible to damage by cross-threading.

Direct Reading, Indicating Pyrometer Controller Provides Straight Line Control

A compact, direct reading, indicating pyrometer controller incorporating a built-in unit to provide straight-line control is currently being offered by *Wheelco Instruments Co.*, 847 W. Harrison St., Chicago 7. The new Model 293 Capacitrol now presents a means of securing a type of proportioning control for processing equipment such as ovens, furnaces, kilns, pots, vats and plastic molding machines, heretofore only obtainable through the use of auxiliary devices or complicated equipment.

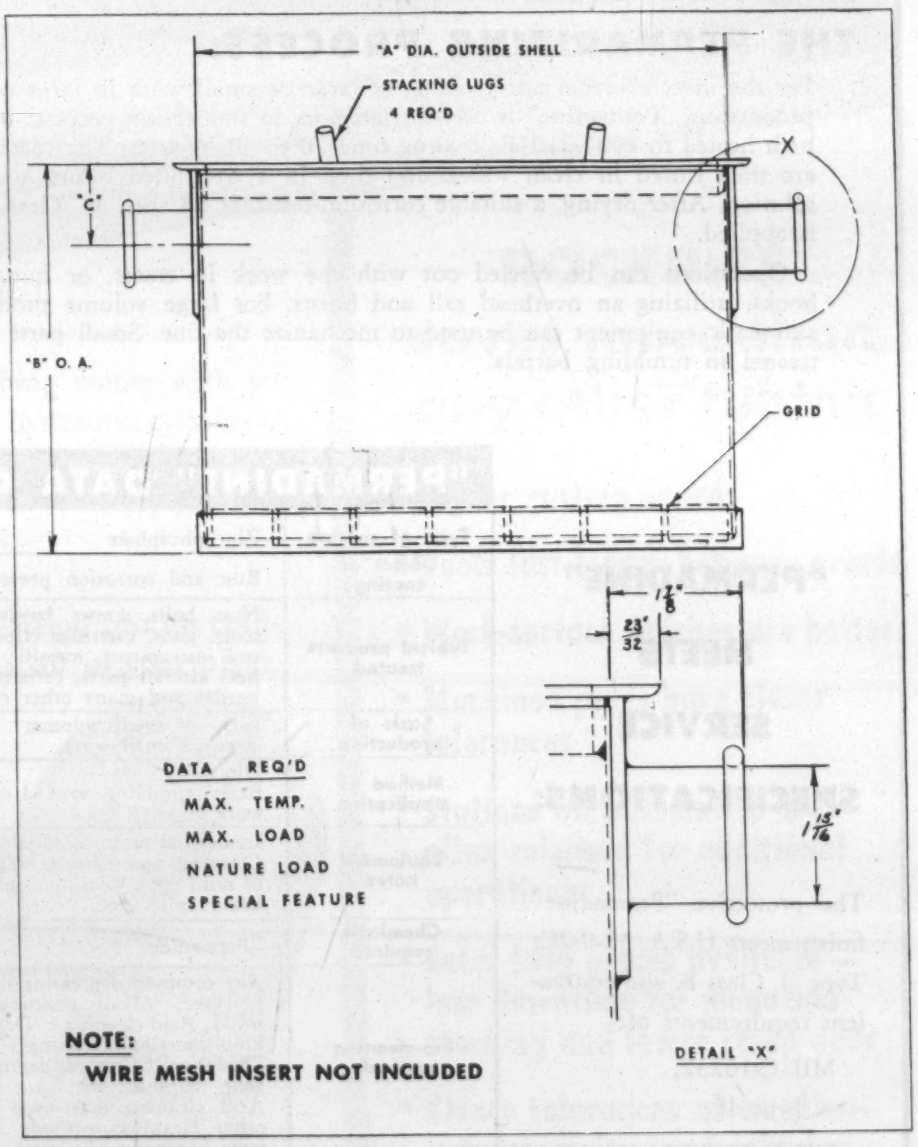
The instrument operates with the same company Electronic link incorporated in the established line of Capacitrol controllers, but adds the new Line-otrol feature to automatically reduce to a minimum the on and off variation of the control instrument above and below the preset control point. Thus, a hair-line control of the

ROLOCK

FABRICATED HEAT AND CORROSION RESISTANT ALLOYS

A Cost-saving method to inquire for... or order...

PIT TYPE FURNACE STACKING BASKETS



Rolock standardized type, fully fabricated-welded alloy baskets are handled as a group, nesting in a pick-up sling. The principal design feature is in the very high live-dead load ratio... one answer to greater service life.

Usual construction employs a fabricated grid (see drawing) but wire mesh, as shown above, may be used. Assemblies to fit standard or existing vertical furnaces can be supplied to your specifications. Use the drawing for quotes or orders.

SEND FOR FULLY ILLUSTRATED CATALOG

Offices: PHILADELPHIA, CLEVELAND, DETROIT, HOUSTON, INDIANAPOLIS, CHICAGO, ST. LOUIS, LOS ANGELES, MINNEAPOLIS, PITTSBURGH

ROLOCK INC. • 1282 KINGS HIGHWAY, FAIRFIELD, CONN.

JOB-ENGINEERED for better work
Easier Operation, Lower Cost

6RL52

AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet

Subject: RUST PROOFING WITH PERMADINE®

INTRODUCTION:

Ferrous metal parts that have been Permadized in a zinc phosphate chemical solution and then "sealed" with a rust-preventive oil such as "Granoleum" are effectively protected from rust-damage. In addition, if the surface is accidentally chipped or scratched, rusting is confined to the exposed area.

Rust proof coatings find many practical applications. During World Wars I and II most small arms were rust proofed by phosphate coating and impregnated with chromic acid and a rust preventive oil, or cutback petrolatum. This not only provided excellent corrosion resistance but also yielded a dull black non-reflecting surface. Rust proof finishes are now used widely on hardware, firearms, cartridge clips, metallic belt links, miscellaneous forgings and castings, tools, unpainted replacement machine parts, and many other similar items such as bolts, nuts, and washers.

THE PERMADIZING PROCESS:

For the most effective rust proofing of large or small work in large or small production, "Permadine" is used in tanks in an immersion process, with the bath heated to 190°-210°F., coating time 20 to 30 minutes. The coated parts are then rinsed in clean water, and then in a controlled dilute acidulated solution. After drying, a suitable corrosion-resistant oil such as "Granoleum" is applied.

Operations can be carried out with the work in crates, or hung from hooks, utilizing an overhead rail and hoists. For large volume production, automatic equipment can be used to mechanize the line. Small parts can be treated in tumbling barrels.

"PERMADINE" MEETS SERVICE SPECIFICATIONS:

The protective "Permadine" finish meets U.S.A. 57-0-2C; Type II, Class B, and equivalent requirements of:

MIL-C-16232,
Type II

U.S.A. 51-70-1,
Finish 22.02, Class B

AN-F-20

Navy Aeronautical M-364

JAN-L-548

"PERMADINE" DATA CHART

Type of coating	Zinc phosphate
Object of coating	Rust and corrosion prevention
Typical products treated	Nuts, bolts, screws, hardware items, tools, guns, cartridge clips, fire control instruments, metallic belt links, steel aircraft parts, certain steel projectiles and many other components
Scale of production	Large or small volume; large or small work
Method of application	Dip Barrel tumbling, racked or basketed work
Equipment notes	Immersion tanks of suitable capacity. Cleaning and rinsing stages can be of mild steel. Coating stage can be of heavy mild steel or stainless steel.
Chemicals required	"Permadine" No. 1
Pre-cleaning methods	Any common degreasing method can be used, Alkali cleaning ("Ridosol"), Acid cleaning ("Deoxidine"), Emulsion-alkali cleaning ("Ridosol"-"Ridoline"); vapor degreasing, solvent wiping, etc., are examples. Acid cleaning may need to follow other cleaning methods if rust or scale is present.
Bath Temperature	190° - 210°F.
Coating time	20 - 30 minutes
Coating weight range Mgs./Sq. Ft.	1000 - 4000
Technical Service Data Sheets	No. 7-20-1-2 T. M. No. 5

CHEMICALS ACP PROCESSES

WRITE FOR FURTHER INFORMATION ON "PERMADINE" AND YOUR OWN METAL PROTECTION PROBLEMS

CHEMICALS ACP PROCESSES

New Materials and Equipment

This direct reading indicating pyrometer controller provides hair-line control of the process variable.

process variable (temperature, etc.) is said to be achieved.

Size of the instrument is 7⅝ in. wide by 8⅛ in. high by 7 25/32 in. deep, making it ideal for space saving, flush or surface mounting on original heating equipment or instrument panels. A wide range of standard scales in various thermocouple calibrations are available.

"Cold" Synthetic Latex Greatly Improved

A major improvement in the quality of synthetic rubber, the production of an odorless latex for use in foamed cushioning, has been announced by *Goodyear Tire & Rubber Co.*, Akron 16. Developed by Goodyear in a research and development program sponsored by the Synthetic Rubber Div., *Reconstruction Finance Corp.*, the new latex is being produced on a pilot plant scale at the Goodyear-operated, government-owned synthetic plant in Akron.

The new material is described as "cold" polybutadiene, meaning that styrene used heretofore with butadiene in "cold" latex production has been entirely eliminated. The material is now identified as Type X-653.

Tube Mills for Producing Welded Nonferrous Tubing

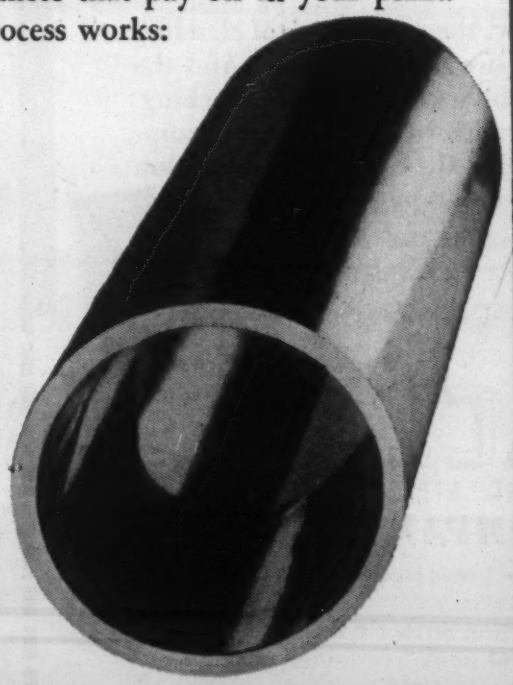
The Yoder Co., 5500 Walworth Ave., Cleveland 2, has announced the development of a machine for producing elecric-

SO HIGH A FINISH...

NEED CYLINDER PARTS? New Rockrite Tubing comes with so high an inside finish that it is ready to go to work as hydraulic cylinders, shock absorbers and similar parts. Smooth, scratch-free inner surface requires *no machining* when used with leather or other soft packings. Only a light honing is needed for metal piston rings.

THE REASON? The Rockrite unique compression-sizing process cold-works the metal . . . insures close tolerances that pay off in your plant. Here's how this distinctively different process works:

- **Dies compress the metal against a mandrel, tending to iron out small irregularities on both the inside and outside surfaces. The metal flows from high spots in the same manner as when it is forged.**
- **A certain amount of planishing action also takes place on the inside surface of the tube as it elongates under the pressure of the dies and creeps forward while in contact with the mandrel.**
- **In no part of this operation is there any action which can produce longitudinal scratches. The metal is not drawn through a die and over a mandrel.**



SIZES? Rockrite cylinder-finish tubing comes in bores from 1½" to 5½", depending on wall thickness. Get additional facts and figures from Joseph T. Ryerson & Sons Company, Chicago, national warehouse distributor, or write us direct.

ROCKRITE saves more than any other tubing

- **Higher cutting speeds**
- **Tools last longer between grinds**
- **Work-surface finishes are better**
- **Machined parts have closer tolerances**
- **Stations on automatics are often released for additional operations**
- **Extra-long pieces available — less downtime for magazine stocking and fewer scrap ends**
- **Closer tolerances often eliminate necessity for machining on outside or inside**

SEND FOR THE NEW 16 PAGE BULLETIN

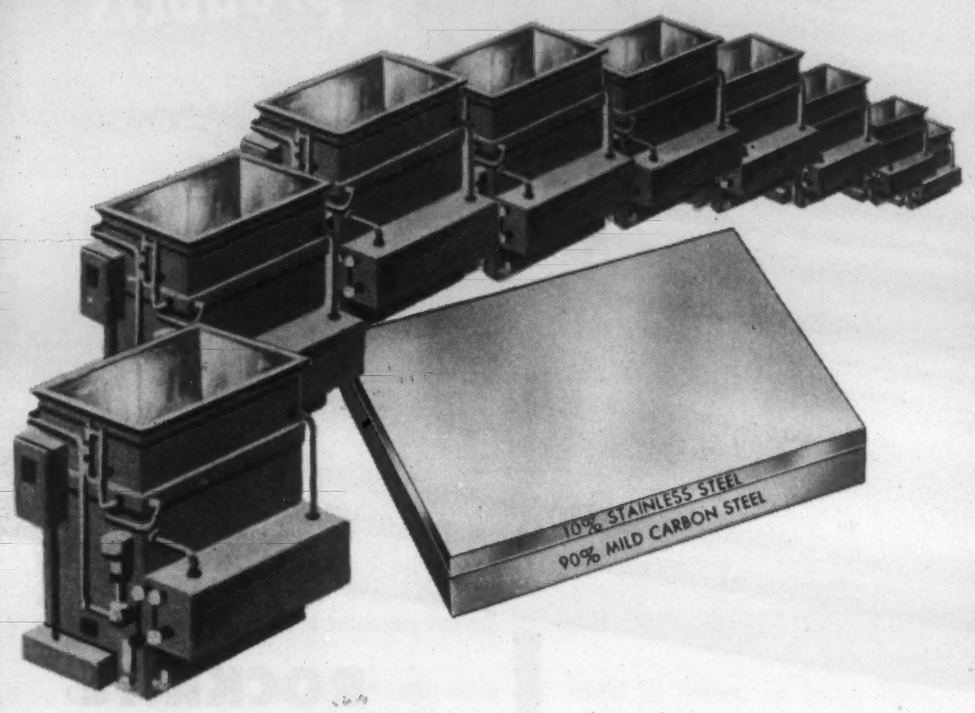
ROCKRITE® TUBING

TR 123A

TUBE REDUCING CORPORATION · WALLINGTON, NEW JERSEY

How to Make Stainless Protection Go NINE TIMES FURTHER... with PERMACLAD

STAINLESS CLAD STEEL



Want stainless protection for your product or equipment—without wasting stainless steel? You'll get it at low cost—with PERMACLAD!

A 10% layer of stainless, inseparably welded to a 90% mild steel backing, gives PERMACLAD the surface characteristics of solid stainless *and* the easy forming qualities of carbon steel. This means real savings in corrosion resistance and in fabrication as well. For you can cold-form PERMACLAD with ease, draw it deeper without intermediate annealing, actually form it into products impossible with many other materials.

Even with the most severe draw, the percentage of cladding (which can be 20% or more if desired) never varies. And the stainless layer remains inseparably welded to its backing. For gleaming, stainless products and corrosion resistant equipment, design and build with PERMACLAD. The coupon below brings you full details in our new 8-page folder (P-97).

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FOR BETTER PRODUCTS AT LOW COST . . . SPECIFY PERMACLAD

ALAN WOOD STEEL CO. ESTABLISHED A.W. 1826 CONSHOHOCKEN, PA.

PERMACLAD
STAINLESS CLAD STEEL

STEEL SCRAP FIGHTS FOR DEFENSE. SELL YOUR SCRAP NOW!

ALAN WOOD STEEL COMPANY Conshohocken, Pa.

Over 125 Years of Iron and Steel Making Experience

Gentlemen:
I am interested in stainless protection with PERMACLAD.
Please send me full information and new, free folder (P-97).

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Company _____

Address _____ *City* _____ *State* _____

Other Products: A.W. ALGRIP ABRASIVE Floor Plate • A.W. SUPER-DIAMOND Floor Plate • Plates • Sheets • Strip • (Alloy and Special Grades)

New Materials and Equipment

ally welded tubing of the principal nonferrous metals. These include practically all aluminum alloys available in coiled sheet form, copper alloys, various brasses, nickel, monel, inconel and stainless steel.

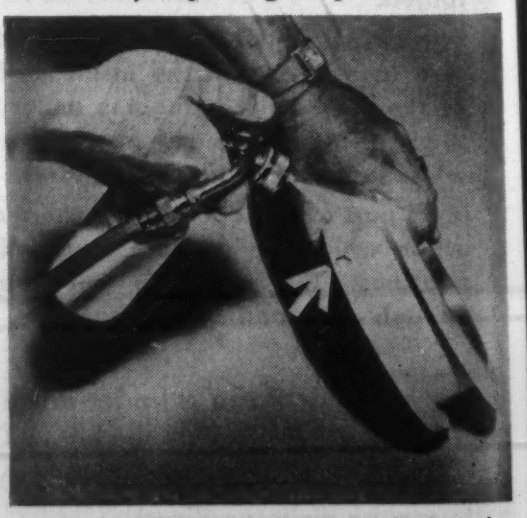
The process employed produces with high weld efficiency a tube comparable in quality to conventional resistance welded steel tubing. At present, the company is offering three sizes of mills which have a total capacity range of ¾- to 8-in. dia., on metal thicknesses ranging from 0.025 up to 0.140 in.

Welding speeds of 50 to 90 ft per min. are practical. This represents an increase of 1000% or more over previous methods of welding these alloys, with a generally superior weld quality, according to the company.

Penetrant Inspection Process for Production Line Inspection

Development of a new type dye penetrant formulated to serve those industries in which production-line inspection is desired has been announced by *Turco Products, Inc.*, 832 E. 62nd St., Los Angeles 1. The new, non-flammable product, Turco Chek-Spek, is a partner of Dy/Chek, the completely flexible dye penetrant inspection process.

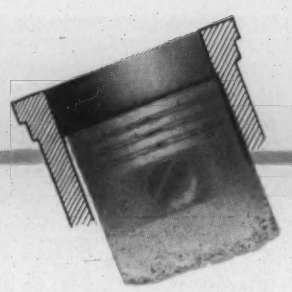
Chek-Spek, when used in conjunction with a vapor degreaser, requires only two materials — Chek-Spek penetrant (flash point 140 F) and Chek-Spek developer (flash point 180 F.) Following pre-cleaning by vapor degreaser, the red penetrant is applied to those parts being inspected. After being allowed to dwell sufficiently long for it to enter even small defects that extend to the surface, the surface dye is removed by suspending the parts for a few



Here the white developer is applied to the part being tested by the new penetrant inspection process.

Beat Wear...

GUN IRON



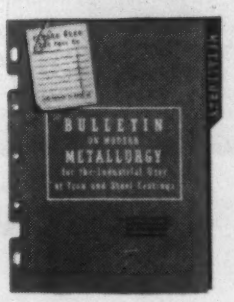
CAST PARTS

It will pay you to investigate Gun Iron for cast parts subjected to frictional wear. Gun Iron's dense, close-grained, microstructure is 100% pearlite with an even distribution of flake graphite throughout and has proven more resistant to wear in literally thousands of applications.

Hunt-Spiller regularly produces wearing parts of Gun Iron such as cylinder liners, rings and pistons for leading diesel manufacturers and operators. These customers have seen the operating economy of Gun Iron in service. Further, they have found they can rely on the dependable accuracy of Hunt-Spiller's manufacturing department.

Gun Iron's resistance to frictional wear as well as heat, pressure and erosion may prove valuable for *your* parts. Our engineers and laboratories stand ready to help you determine its specific advantages. Call on them. **HUNT-SPILLER MANUFACTURING CORP., 371 Dorchester Ave., Boston 27, Mass.**

Canadian Representatives: Jos. Robb & Co., Ltd., 4050 Namur St., Montreal 16, P.Q.; *Export Agents:* International Rwy. Supply Co., 30 Church St., N.Y. 7, N.Y.



HERE IS A PRACTICAL GUIDE for the user of iron and steel castings . . . 24 pages of technical data on many types of metals and alloys. Write for your free copy.

MEASURE IN MICROINCHES RMS

Production Efficiency

increased

because BELL Aircraft CORPORATION **uses the PROFILOMETER**

Bell Aircraft Corporation of Buffalo, New York, in production of Guided Missiles, Supersonic Aircraft, Rocket Motors and Airborne Electronic Equipment finds the Profilometer has increased their production efficiency. At Bell the development of guided missiles is of great magnitude. While the work in this field is of a restricted nature, it can be reported that the Profilometer has become of standard use in production techniques.

A specific example is Bell Aircraft production of high precision valves. Extreme surface accuracy in machining these high precision valves is of prime importance. For these surface measurements Bell turned to the Profilometer for the necessary answers. The I.D. surface of these valves, shown being measured above, must produce a maximum reading of four microinches! Bell found that the Profilometer would give these readings fast and accurately thus saving valuable machining time in production.

Extremely accurate surface measurement is essential to Bell Aircraft today in research and production. The Profilometer is supplying this information. This is just another example of the use of the Profilometer as an important *shop instrument.*

To learn how the Profilometer can help cut costs in your production, write today for these free bulletins.

Profilometer is a registered trade name.

MICROMETRICAL MANUFACTURING COMPANY

formerly PHYSICISTS RESEARCH COMPANY

Instrument Manufacturers

ANN ARBOR 14 MICHIGAN

New Materials and Equipment

seconds in the vapor zone of a vapor degreaser. Following dye removal, the white developer is sprayed onto the parts being inspected. Strong developer capillary attraction pulls out the dye which has remained trapped in existing flaws. As the developer dries, the red dye bleeds into it, clearly locating and defining the extent of existing flaws.

Like Dy/Chek, the new method requires no royalty fee, licensing fee or technical service charge, and is applicable to both ferrous and nonferrous metals. While it is recommended that the developer be sprayed onto the surface, it can also be applied by dip or brush.

Aluminum Paste Imparts Brighter Finish

Greater two-tone, flash and glamour for polychrome or metallic finishes are now said to be possible through the use of a new aluminum paste made by *Aluminum Co. of America*, 801 Gulf Bldg., Pittsburgh 19. Designated as Aluminum Tinting Paste #222, the pigment is said to give a brighter finish than has been possible thus far with other aluminum pigments.

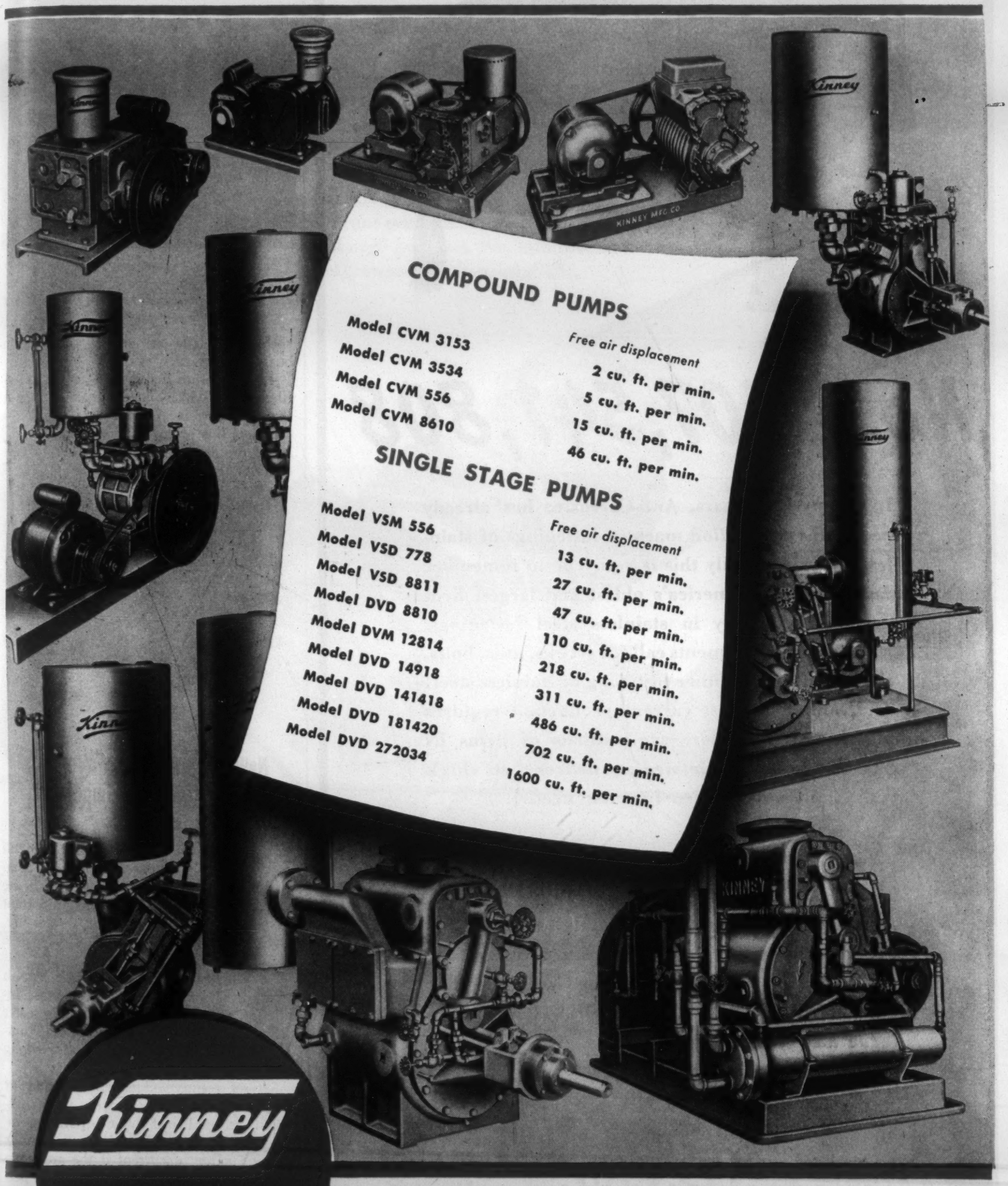
The paste does not interfere with true color values, gives a clean appearance of great depth to the finish, and while achieving the utmost in iridescence, it is characterized by an absence of seeding.

While primarily intended for automotive finishes, the paste also imparts a striking, beautiful effect to the hammer-tone finish on household equipment and appliances. Metal content of the paste is 65%, the specific gravity is 1.47, weight per solid gallon is 12.245, and it has a bulking value of 0.0820 gal per lb.

Die Cast Zinc Alloy Screws Designed for Many Uses

Die casting is achieving important economies in the production of wood screws for soft materials, according to *Gries Reproducer Corp.*, 780 E. 133rd St., New York 52. GRC die cast zinc alloy wood screws are designed for a wide range of uses, and are said to offer many application advantages for manufacturers using

THE BIG LINE OF VACUUM PUMPS



COMPOUND PUMPS

	Free air displacement
Model CVM 3153	2 cu. ft. per min.
Model CVM 3534	5 cu. ft. per min.
Model CVM 556	15 cu. ft. per min.
Model CVM 8610	46 cu. ft. per min.

SINGLE STAGE PUMPS

	Free air displacement
Model VSM 556	13 cu. ft. per min.
Model VSD 778	27 cu. ft. per min.
Model VSD 8811	47 cu. ft. per min.
Model DVD 8810	110 cu. ft. per min.
Model DVM 12814	218 cu. ft. per min.
Model DVD 14918	311 cu. ft. per min.
Model DVD 141418	486 cu. ft. per min.
Model DVD 181420	702 cu. ft. per min.
Model DVD 272034	1600 cu. ft. per min.

Kinney
VACUUM PUMPS

There's a Kinney Pump for every vacuum requirement. Write for Bulletin V-51B.
Kinney Manufacturing Co., 3523 Washington St., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Philadelphia, Houston, New Orleans, Los Angeles, San Francisco, Seattle.
FOREIGN REPRESENTATIVES: Gen'l Engineering Co., Ltd., Radcliffe, Lancs., England. • Horrocks, Roxburgh Pty., Ltd., Melbourne, C. I. Australia • W. S. Thomas & Taylor Pty., Ltd., Johannesburg, South Africa • Novelectric, Ltd., Zurich, Switzerland • C.I.R.E., Piazza Cavour 25, Rome, Italy.

No. 2,107,541,808

In twenty-five years, Anti-Corrosive has already passed the *two billion* mark in fastenings of stainless steel! Certainly this is your cue to remember Anti-Corrosive, America's oldest and largest firm dealing *exclusively* in stainless steel fastenings, when your requirements call for screws, nuts, bolts, rivets, pins or any other fastening of stainless steel! And, although most current *production* requires priority ratings, there are millions of items IN STOCK, ready for *immediate delivery*, so check with Anti-Corrosive *first* for your needs!

FREE—A-N Stainless Fastening Selector

A handy slide-chart which instantly identifies A-N Nos. pertaining to stainless steel nuts, screws, bolts, rivets, cotter pins, washers; gives sizes and other data. Write for "Chart 52L" TODAY! Free catalogue also available.

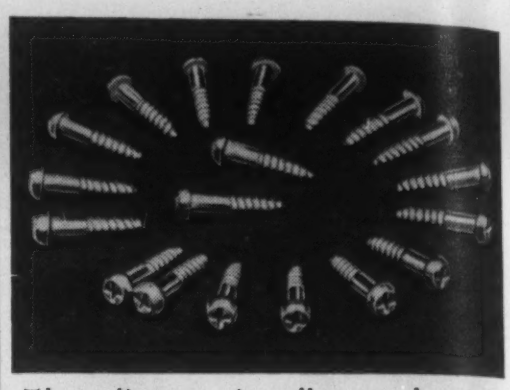
25 YEARS OF LEADERSHIP IN FASTENINGS OF STAINLESS STEEL

Anti-Corrosive Metal Products Co., Inc.

Manufacturers of STAINLESS STEEL FASTENINGS

CASTLETON-ON-HUDSON, NEW YORK

New Materials and Equipment



These die cast zinc alloy wood screws offer advantages to those using such materials as soft woods, composition board and plastics.

such materials as soft woods, composition board and plastics.

In addition to the #1X⅜ wood screws illustrated, which have Frearson heads, the company is planning to produce a complete line of sizes. The design flexibility of the die casting process permits production of any type of head and driver recess.

The rust-proof wood screws are cast and trimmed, ready for surface finishing, in one single completely automatic operation. The threads are cast and can be held to required close tolerances because of the use of single-cavity precision dies.

New Line of A.C. Welders Incorporate Three Important Features

Metal & Thermit Corp., 100 E. 42nd St., New York 17, has announced a complete new line of a.c. welders which are said to incorporate three highly important features contributing to longer welder life, improved performance, and a high degree of operator acceptance.

First of these features is insulation with silicone. The use of this semi-organic insulating material is said to provide greater overload capabilities, permit more compact, lighter weight design, and prolong welder life.

Second feature is the combination of low open circuit voltage with arc stabilization, accomplished by incorporating capacitors in the secondary circuit to provide an extra surge of current if the arc starts to go out. The result is smoother performance and elimination of "pop-outs".

An automatic hot-start is the third feature incorporated into the new welder. This is said to make arc striking easy by providing just the right amount of cur-

(Continued on page 170)

you get easier machining and forming

with **Pittsburgh**

SEAMLESS COLD DRAWN TUBING

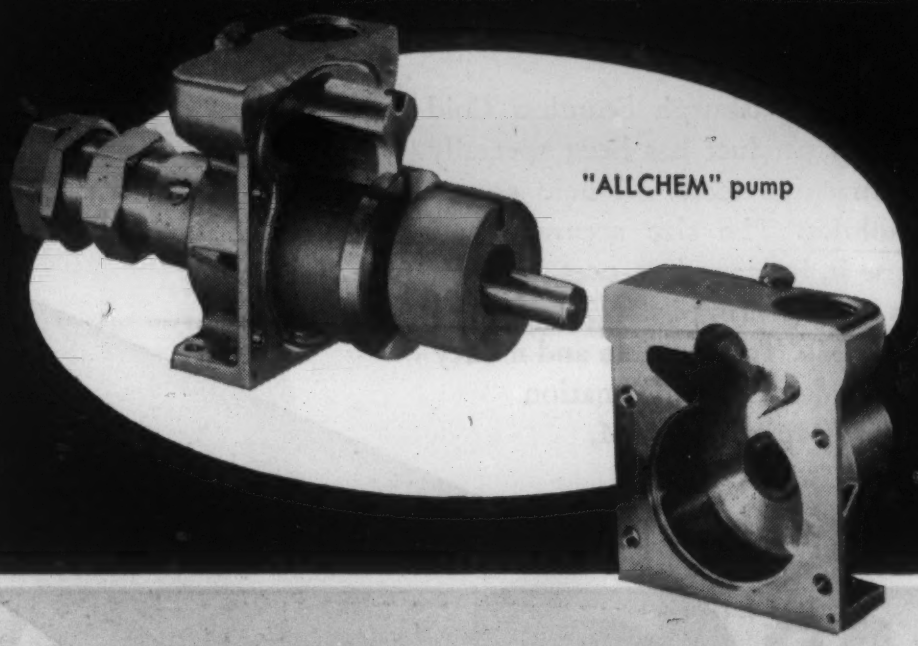
The fact that you enjoy production ease with Pittsburgh Seamless Cold Drawn Tubing is no mere chance, because this product has been specially developed for precision parts of ordnance, machine tools, oil field equipment, farm machinery, trucks and automobiles. The size accuracy and finish of Pittsburgh Seamless enables you to use it, in many instances, without the necessity of further machining. It also has the uniform physical properties that make big, high-speed production runs possible. To save time and money with *all* your operations specify Pittsburgh Seamless. For information on how to order, write Pittsburgh Steel Company, Department MM, Grant Building, Pittsburgh 30, Pa.

The Steel Industry Needs Scrap— *Keep it Moving*

Pittsburgh Seamless Cold Drawn Tubing

A product of PITTSBURGH STEEL COMPANY

"Engineered Fluorocarbons"
MADE THIS CHEMICAL PUMP POSSIBLE



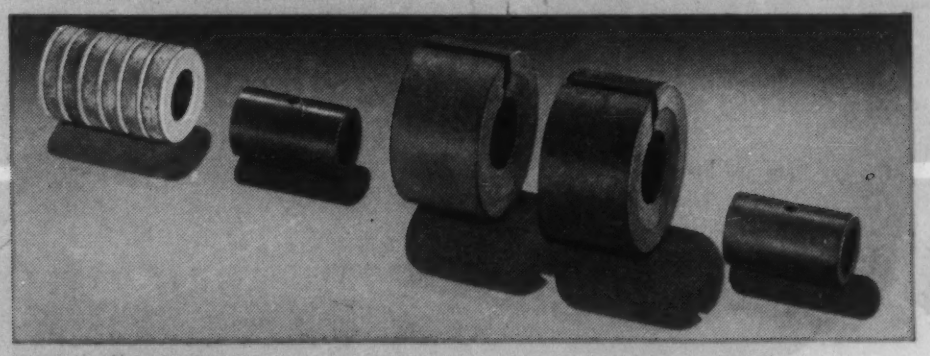
Impellers, bearings, packing of Chemelec Mixtures (TEFLON*-PLUS) are impervious to chemicals and are non-contaminating, minimize friction, maintain high efficiency.

Eco Engineering Company of Newark, New Jersey, makes this "ALLCHEM" pump, suitable for pressures up to 70 lbs., at 3400 R.P.M., for pumping anything that glass can handle—acids, alkalis, solvents, oils, pharmaceuticals, biologicals—without chemical attack or contamination.

Chemelec Mixtures are duPont Teflon to which another material has been added in its fabrication to impart some characteristic which the pure fluorocarbon does not possess.

These Teflon "alloys" offer an almost limitless series of new materials for the designing engineer. Bring us your problem and we will work with you to determine the Chemelec Mixture best suited to your requirements of hardness, wear resistance, dimensional stability, chemical resistance, anti-friction qualities, dielectric or conduction qualities, permanent magnetism, resistance to neutron bombardment, etc.

Also, there are metal surfaced materials which may be soldered to, and materials which are cementable.



UNITED STATES GASKET COMPANY

FLUOROCARBON PRODUCTS DIVISION

FABRICATORS OF "TEFLON", "KEL-F" AND OTHER FLUOROCARBON PLASTICS

CAMDEN 1, NEW JERSEY

*duPont's trademark for its tetrafluoroethylene resin

New Materials and Equipment

This new a.c. welder features silicone insulation, automatic hot-start, and the combination of low open circuit voltage with arc stabilization.

rent boost to start the arc at any current setting without manual adjustment. The hot-start device is a simple relay and resistor combination connected across the transformer secondary in series and is fully automatic in operation. Controls of the mercury relay are sealed in and no maintenance is required at any time.

New Coating Protects Steel Sheets Against Corrosion

Mid-America Steel Warehouse, Inc., Chicago, has announced a new coating that is said to be not only a better prime coating or finish, but also to be harder and more durable than any other known method of protecting steel sheets against corrosion and excessive heat.

According to the company, the new process is called Leafcote, and it carries phosphatizing and painting a step further. After both sides of either a cold or hot rolled steel sheet have been degreased, pickled and phosphatized, they are heated, after which Leafcote is bonded and baked on for toughness and lasting adhesion.

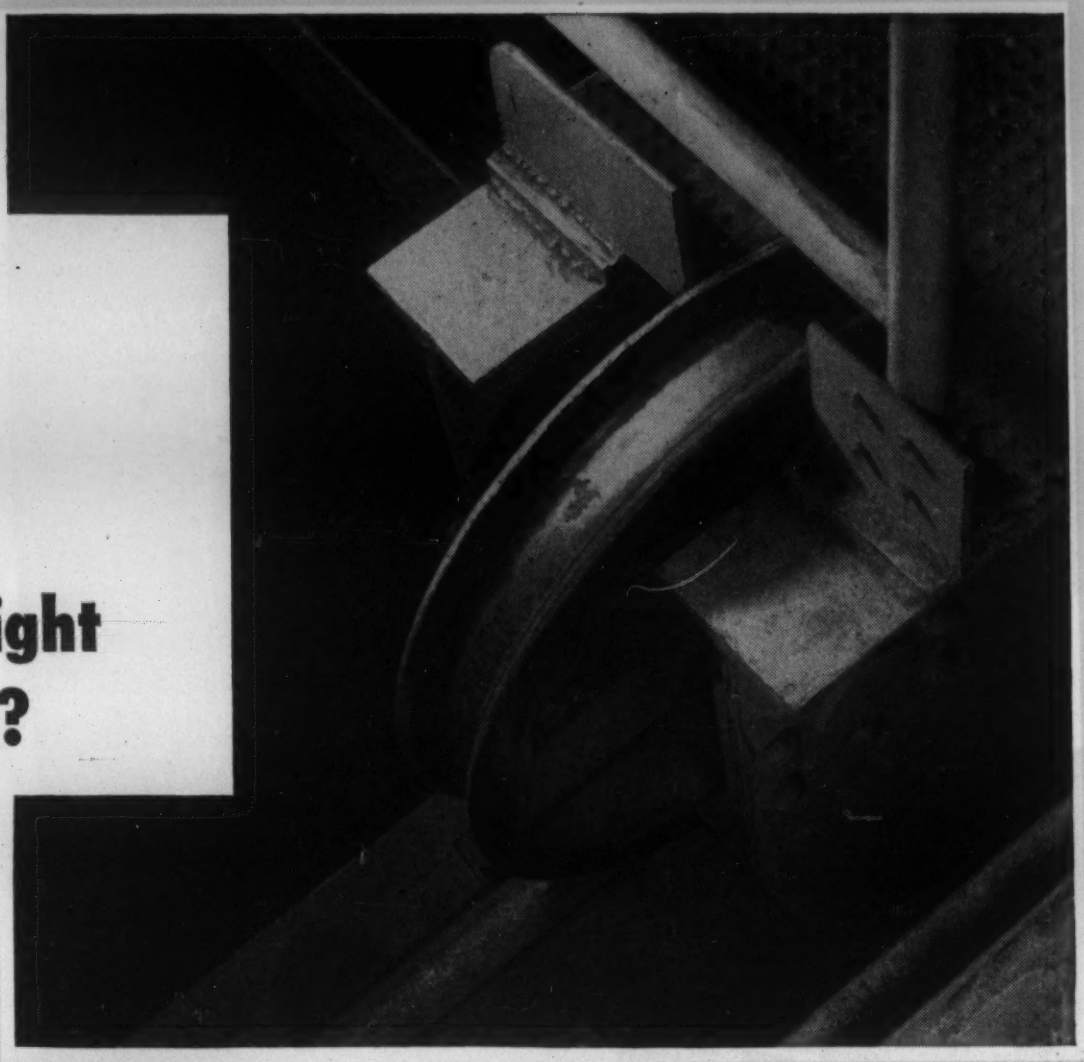
The new coating can be used as a prime

PRODUCT—
Crane Wheel

MATERIAL—
Steel

EQUIPMENT—
1000 kv x-ray unit

What's the right X-ray film?



KODAK INDUSTRIAL X-RAY FILM, TYPE A

Failure of any of this crane's wheels would stymie the smooth production of the plant. So the smart order was "Radiograph them."

To make the radiographs, the radiographer used 1000 kv, 4-min. exposure at 8-feet tube distance, and Kodak Industrial X-ray Film, Type A.

This film has fine graininess with high contrast and sufficient speed to take full advantage of high kilovoltage equipment in radiographing thick or dense materials. It is also first choice for the examination of light alloys with short exposures at low voltages.

A TYPE OF FILM FOR EVERY PROBLEM

To provide the recording medium best suited to any combination of radiographic factors, Kodak produces four types of industrial x-ray film. These provide the means to check castings and welds efficiently and thus extend the use of both processes.

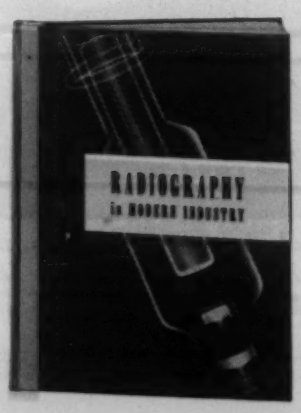
Type A—has high contrast and fine graininess with adequate speed for study of light alloys at low voltage and for examining heavy parts at intermediate and high voltages. Used direct or with lead-foil screens.

Type M—provides maximum radiographic sensitivity, with direct exposure or lead-foil screens. It has extra-fine grain and, though speed is less than Type A, it is adequate for light alloys at average kilovoltages and for much million- and multi-million-volt work.

Type F—provides the highest available speed and contrast when exposed with calcium tungstate intensifying screens. Has wide latitude with either x-rays or gamma rays when exposed directly or with lead screens.

Type K—has medium contrast with high speed. Designed for gamma ray and x-ray work where highest possible speed is needed at available kilovoltage, without use of calcium tungstate screens.

Radiography . . . another important function of photography



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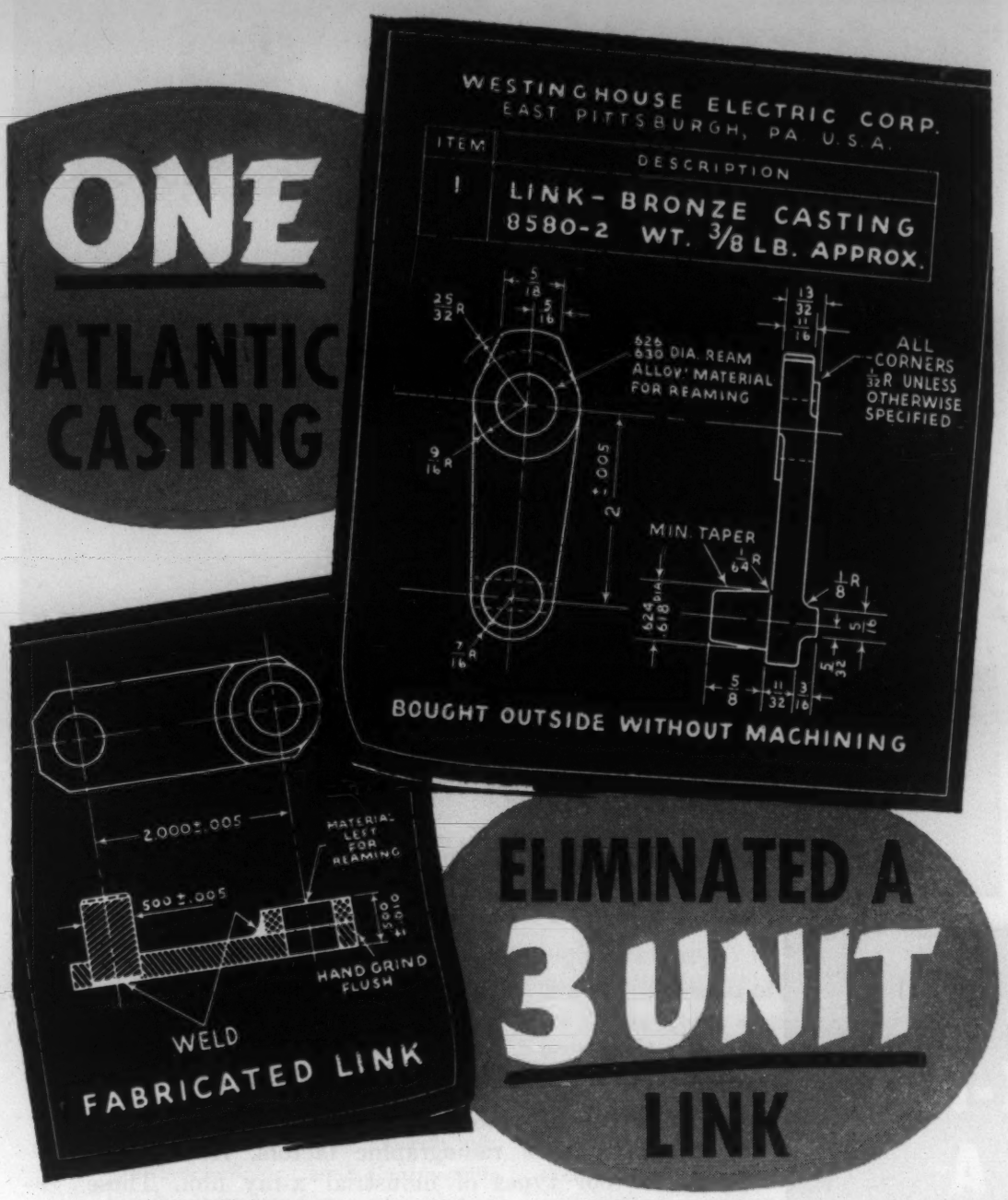

FOR Westinghouse!

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Atlantic's engineers suggested a design that resulted in a part cast in ONE PIECE from Atlantalloy #31 High Tensile Manganese Bronze . . . a dependable engineering material that is stronger than many steels. This one piece casting eliminated the involved machining, welding and finishing steps—and consequently afforded a substantial saving over former costs.

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New Materials and Equipment

coating or it can be finished in any color desired. However, as a prime coating, it is claimed to be excellent where a quality finish is demanded. And, in addition to withstanding high temperatures longer, and being more resistant to corrosion, the new formula draws and forms without peeling or cracking.

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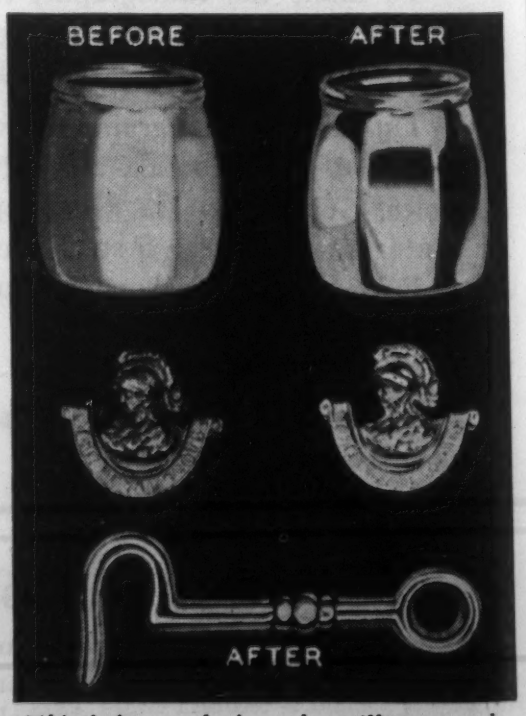

This before and after photo illustrates the quality of finish obtained with the new barrel burnishing emulsion.

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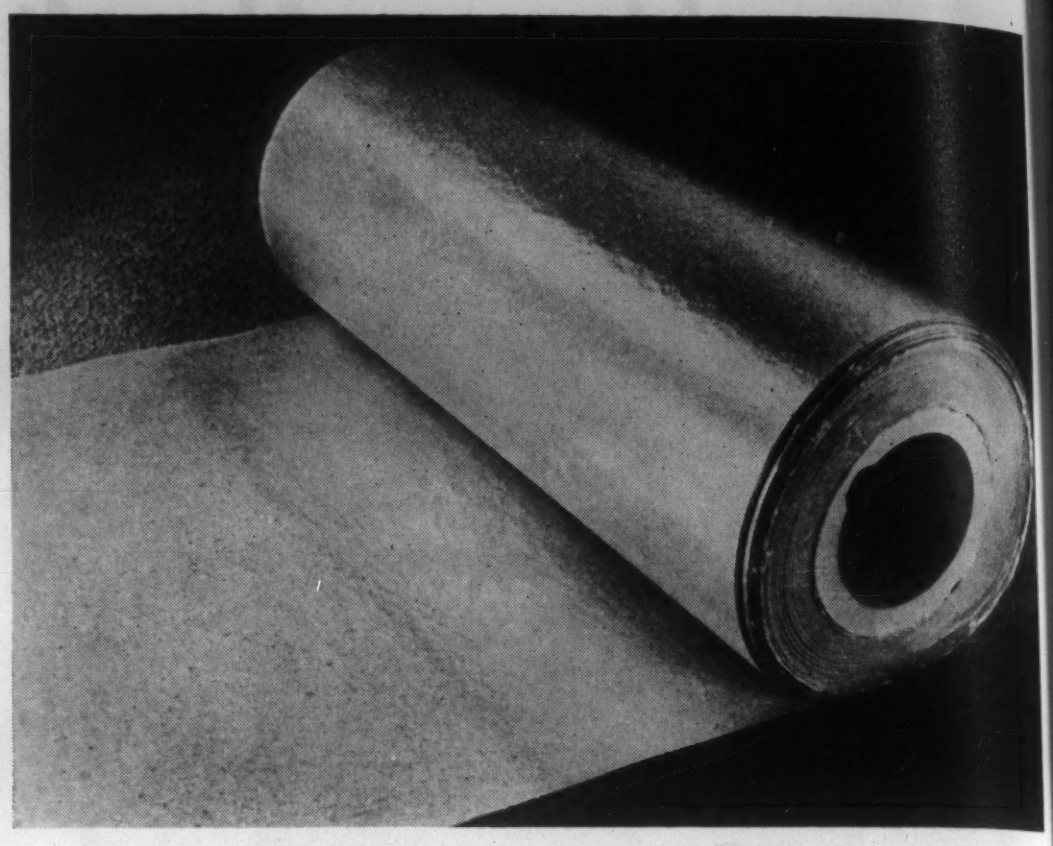

A roll of silvery mica paper, extremely uniform in weight and thickness.

Mica Paper
Developed for Electrical Insulation

by R. L. Griffeth and E. R. Younglove, Mica Insulator Co.

● MICA IN THE FORM of mica paper will soon make its appearance as a component of electrical insulation. The use of mica in this form constitutes a significant advancement in micaceous insulation.

When the electric motor and the electric generator were first developed, the importance of mica sheet as insulation material was recognized. This natural sheet was only a small percentage of the total mica mine output, however. It was then found possible to split the smaller grades of mica into thin sheets and cement them together to form large sheets. This built-up insulation is still made from bonded splittings. The development of mica paper is one step further. This paper can be made from the lower grade forms of mica which could not be used in the bonded splittings material.

Manufacture

The credit for first processing mica into continuous sheets belongs to a Frenchman, Jacques Bardet. The result of his investigations was not the one which he expected. He was seeking to make mica dust by treating mica thermally and chemically, but upon filtering and drying he found not a mica dust, but a coherent sheet.

The production of mica paper is in some ways not unlike the conventional manufacture of paper from wood pulp. The raw material for mica paper is muscovite mica in the form of mine waste, scrap or recovered mica. The mica is first heated to a temperature sufficient to induce partial dehydration of the mica. The loss of some of the water of crystallization modifies the crystal and produces a noticeable swelling of the mica. As the hot mica emerges from the treating furnace it is immersed in a saturated solution of sodium carbonate or bicarbonate.

The local boiling in this solution expels the air from the interlamillar structure of the mica, already swelled as a result of heating. Upon cooling, the mica appears as thin layers

(Continued on page 176)

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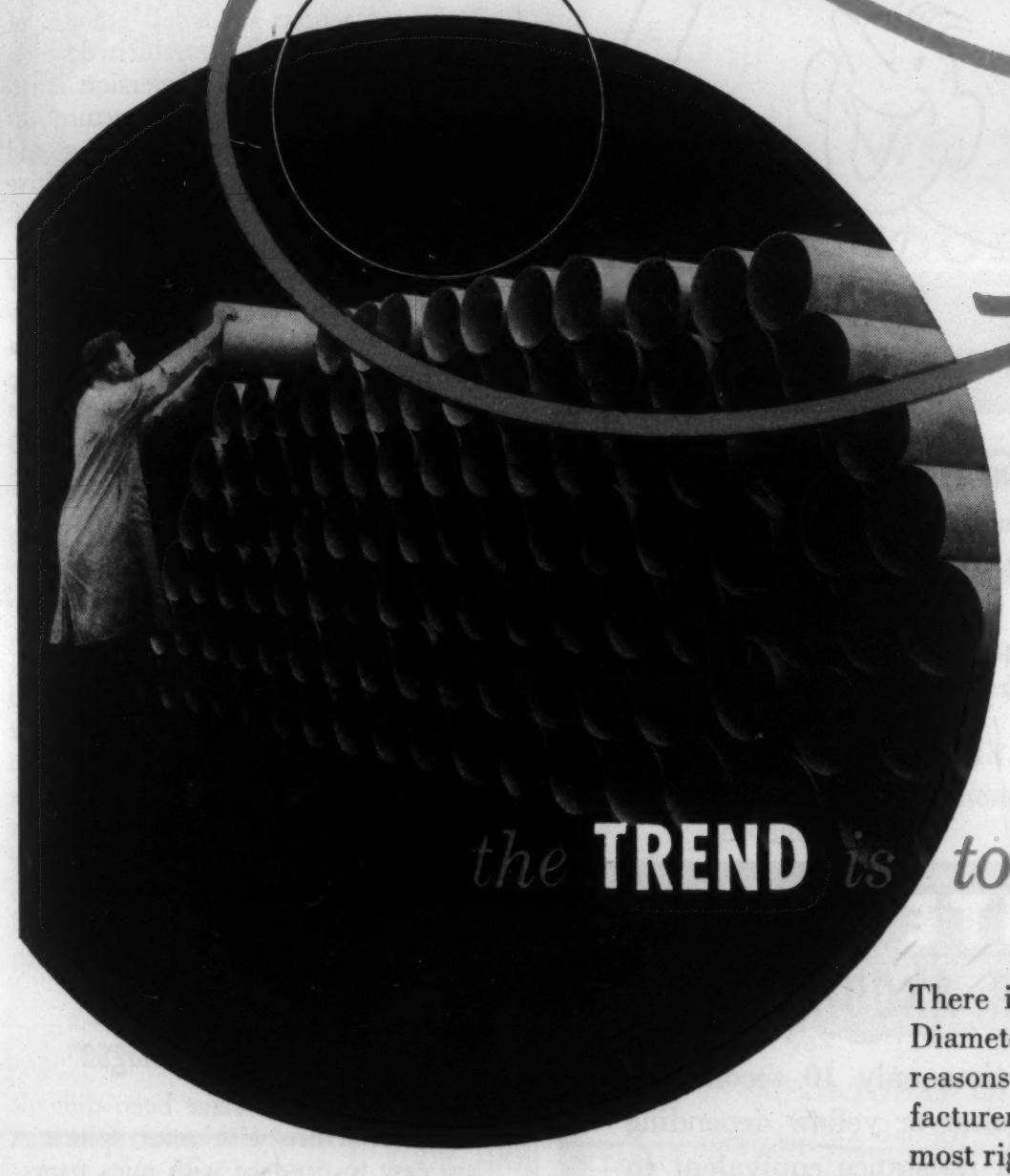

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Mica Paper . . .

Continued from page 174

scarcely adhering to each other and retaining a large amount of the alkaline solution. The mica is allowed to drain before immersion in a strong solution of hydrochloric acid or sulfuric acid. The resultant gaseous reaction puffs the material to a very great extent. The coherence of the strata of mica in this state is very weak, and only washing and agitation are required to produce a suitable pulp.

Mica paper can be made on a conventional Fourdrinier type of paper machine. A small amount of special melamine formaldehyde resin in an acid colloidal dispersion is necessary to give the mica structure sufficient strength for processing and also to make it much less sensitive to the effect of high relative humidity. In this form there is a similarity between sized cellulose paper and mica paper. Mica paper is composed of a large number of mica layers of extreme thinness, of the order of a few hundred thousandths of an inch. Some of the mica flakes attain a surface area as large as one-tenth of a square inch.

The mica paper as it comes from the paper machine has about one-half the density of natural mica because of the air between the layers. The tensile strength of the paper depends on the source of the mica and its treatment. Mica paper does not compare with mica splittings in mechanical or electrical properties as it comes from the machine, but in combination with suitable bonding agents, products can be made which are superior to conventional electrical insulation now being made with mica splittings.

Applications and Advantages

Products which have been difficult to manufacture with mica splittings are easy to produce with mica paper. One of the best illustrations of the versatility of mica paper is its use as a component in a silicone molding plate. For the last few years, manufacturers of micaceous insulation have tried to produce a silicone hot-molding plate which could be used for ground insulation on motors and generators. Using an experimental silicone resin which had proved unsuccessful for this application with mica splittings, molding plates were made with mica paper. Channels were easily formed after heating pieces of the hot molding plate for a few seconds at 329 F.

(Continued on page 178)

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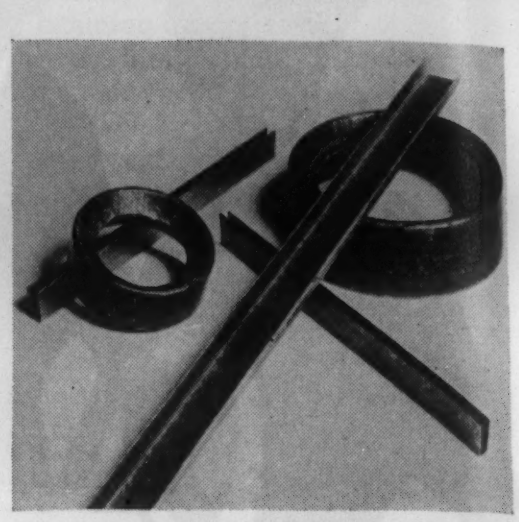
Mica Paper . . .

Continued from page 176



Channels and commutator rings formed from built-up mica paper.

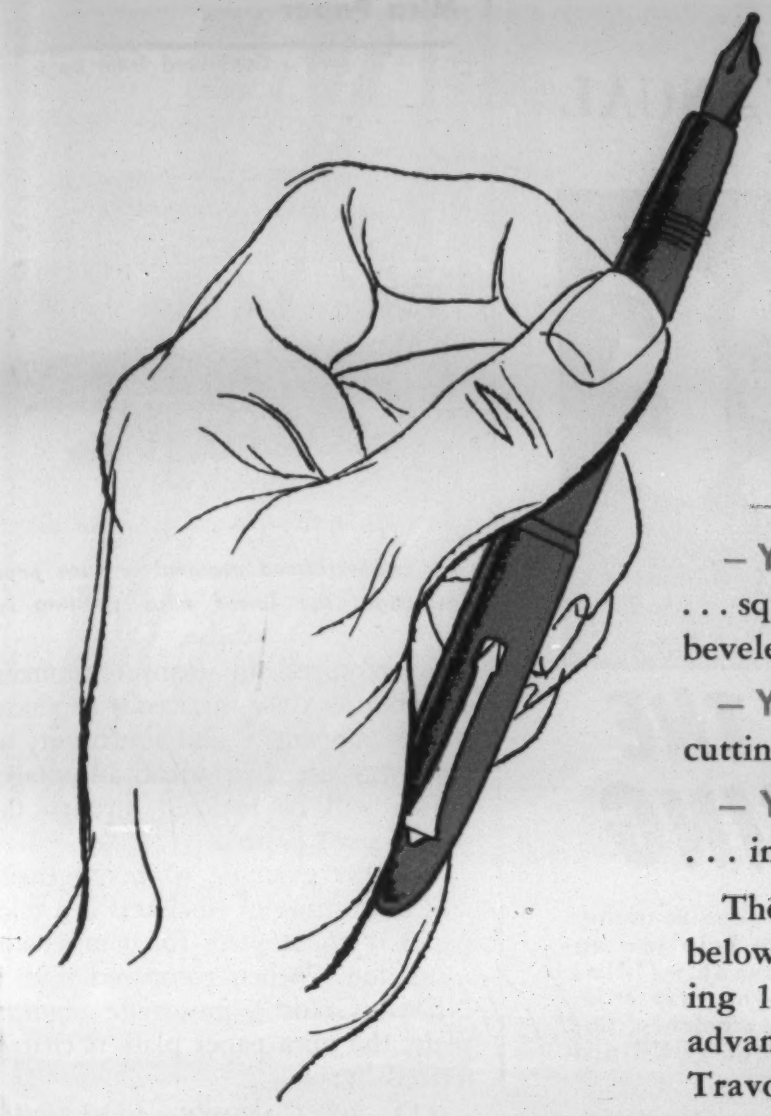
These channels have been kept in a standard laboratory atmosphere for periods well over six months and at a relative humidity of 96% for over two months with no apparent change in shape. Using mica paper, it has been possible to maintain a tolerance of $\pm$0.002 in. on average thickness without sanding.

The silicone hot-molding plate can also be molded to other more intricate shapes without difficulty. The dielectric strength of an 18-mil silicone molding plate with 2-mil glass on each side is about 1900 v per mil of thickness with very little difference between the maximum and minimum values. The power factor at one megacycle is about 0.5%, but there is some evidence that the power factor at 60 cycles is somewhat higher.

The coating of mica paper for flat pieces is achieved by either spray or dip coating. With dip coating, a process which is impossible with mica splittings, it is possible to attain a very uniform distribution of binder over both surfaces of the paper. The uniformity of the paper and coating makes possible a uniform cure.

Pressed plates from this coated paper are very homogeneous and devoid of pockets of shellac or other binder. Such pockets have always been a source of trouble in older types of mica insulation. In laying up plies of a uniformly coated mica paper, it could be expected that the finished plate would be extremely uniform in thickness. Experience has shown that in many products milling to thickness is unnecessary. Uniformity of thickness of mica paper products, combined with inherent homogeneity, undoubtedly will reduce the necessity of conducting high potential tests on each sheet, as is

(Continued on page 180)



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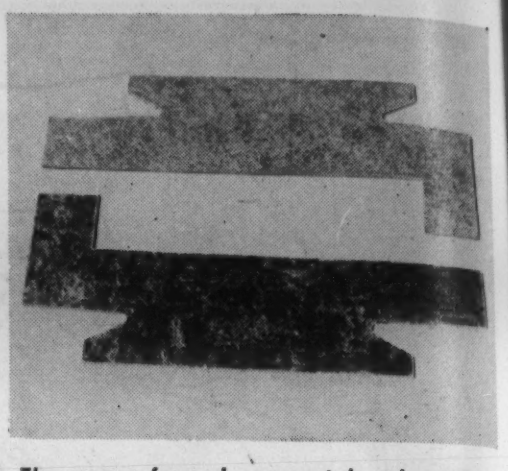
Mica Paper . . .

Continued from page 178



The upper formed segment is mica paper insulation, the lower mica splitting insulation.

now required in many customers' specifications for micaceous products. The homogeneity and uniformity of thickness are two great advantages which will be realized through the use of mica paper.

Another example of homogeneity and uniformity of thickness is a mica paper segment plate for commutator insulation. When compared with a NEMA Grade 3 muscovite segment plate, the mica paper plate is characterized by:

(1) lower density, (2) greater uniformity of thickness, (3) almost equal compressibility, (4) excellent compressive strength at elevated temperatures, (5) better punchability, (6) higher accuracy of fabrication in sawing, milling, etc., (7) lower hardness, and (8) more uniform bond content.

The thickness tolerances of the unmilled mica paper segment plate are good enough to meet all but the most exacting requirements.

The lower hardness of the mica paper segment plate is a result of the partial dehydration of the mica during the paper-making process. This lower hardness suggests that the wear of commutator segments will be practically the same as that of the copper. The final answer, relative to the necessity of undercutting commutator segments made with mica paper, can only be determined through functional evaluation of this new product. One application for mica paper segment plate which must be carefully evaluated is its use in traction motors. There is a question whether the mica paper product will stand up under heavy vibrations found in such motors.

The homogeneity of the mica paper sheet decreases the danger of sliding of the mica or oozing of the binder. The reason for this is that pockets of binder or concentrations of mica can be completely eliminated.

(Continued on page 182)

Steel veins for iron horses

Steel veins for iron horses—strong, durable veins easily forged and fabricated to exact requirements—this is but one of the many applications for OSTUCO Tubing in products of modern design, products that strengthen America and the free world.

OSTUCO Tubing presents endless opportunities for improving design in almost every field. In addition to infinite adaptability, OSTUCO Tubing offers such advantages as maximum strength with minimum weight, good surface conditions for finishing, excellent machinability, and low cost. We cannot always promise early delivery estimates on new civilian orders, because of military demands, but it will pay you to consult our experienced engineers about OSTUCO Tubing when redesigning your products to meet future competition.

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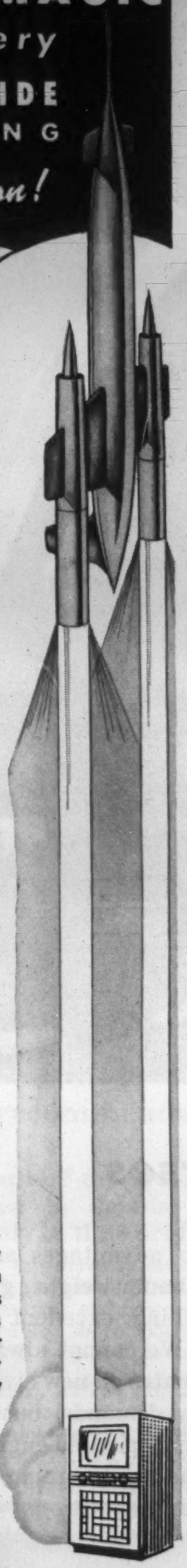

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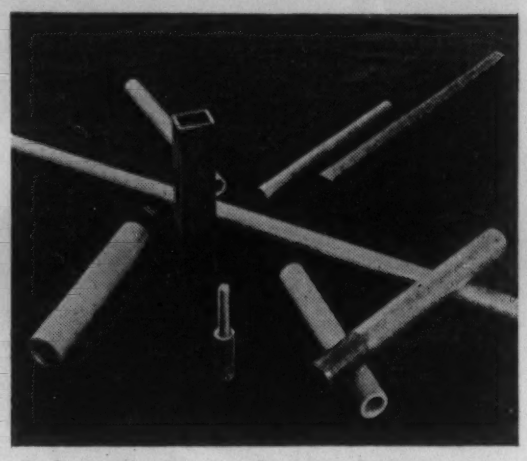
Mica Paper . . .

Continued from page 180



Rods and tubes made from built-up mica paper. Built-up mica paper can be machined, punched, tapped and threaded.

In small segments of relatively heavy thickness, the splitting and flaking of micanite products has always been a source of trouble, especially in assembly. However, similar segments produced from mica paper show no tendency to split or flake.

The dielectric strength of 32-mil segment plate is about 1200 v per mil. This is double the NEMA value for average dielectric strength. Because of the homogeneity of the product, the dielectric strength is uniform not only throughout a single sheet, but is also from sheet to sheet.

Tapes can be made from mica paper in almost all of the combinations where mica splittings are now used. The emphasis is again on uniformity. The uniformity of the mica paper eliminates the high and low thickness spots which are always present in tapes made with mica splittings. This uniformity in thickness gives a neat and compact wrapping on coils and bars. The dielectric strength of mica paper tapes does not show the wide variations that are commonly found in tapes made with mica splittings. Tapes made from mica paper do not have the voids that have long proved a source of trouble to both manufacturer and consumer.

New varieties and forms of insulation can be made by using mica paper. Many items of specialty insulation made with mica splittings can now be made with mica paper. At present, it is believed that eventually mica paper can replace mica splittings in all grades of micaceous insulation and will also find new uses in electrical insulating products where mica splittings cannot be successfully used.

The strategic value of mica paper is important. Mica is listed as a strategic mineral in rather short supply, with a large part of our muscovite

(Continued on page 184)

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Photo courtesy Whirlpool Corporation, St. Joseph, Michigan

Saved Six $1200 Failures in 18 Months

In exhausting fumes from a line of paint spray booths, this 20 hp fan motor repeatedly painted itself to death. After about 3 months of service, the paint built up so heavily on the fan blades that the motor burned out. Each failure halted production on a 300 man assembly line; cost over 450 man hours or about $1200 per failure.

Maintenance engineers had to choose between having the fan cleaned every day, installing a larger motor, or rewinding the old one with Dow Corning Silicone (Class H) Insulation. The economy of choosing Silicone insulation is proved by the fact that this motor, rewound with Class H materials, has been operating 20 hours a day for over 18 months, or 6 times its previous life. Savings so far amount to about $7200.00.

Such performance in thousands of installations has proved that Dow Corning Silicone (Class H) insulation has 10 to 100 times the life expectancy of the next best class of insulating materials; increases the power per pound ratio in electric machines by as much as 50%.

Eliminate another common cause of motor failure; lubricate bearings with Dow Corning 44 Silicone Grease.

Especially designed for ball bearings operating at a maximum speed factor (bore in m.m. x rpm) of 150,000 to 200,000 and at temperatures from —40° to 400°F, Dow Corning 44 Grease is practically nonvolatile and highly resistant to oxidation. In open and single shielded bearings designed for high temperature operation, Dow Corning 44 has 8 to 10 times the life expectancy of conventional greases. It gives life-time lubrication in permanently sealed bearings.

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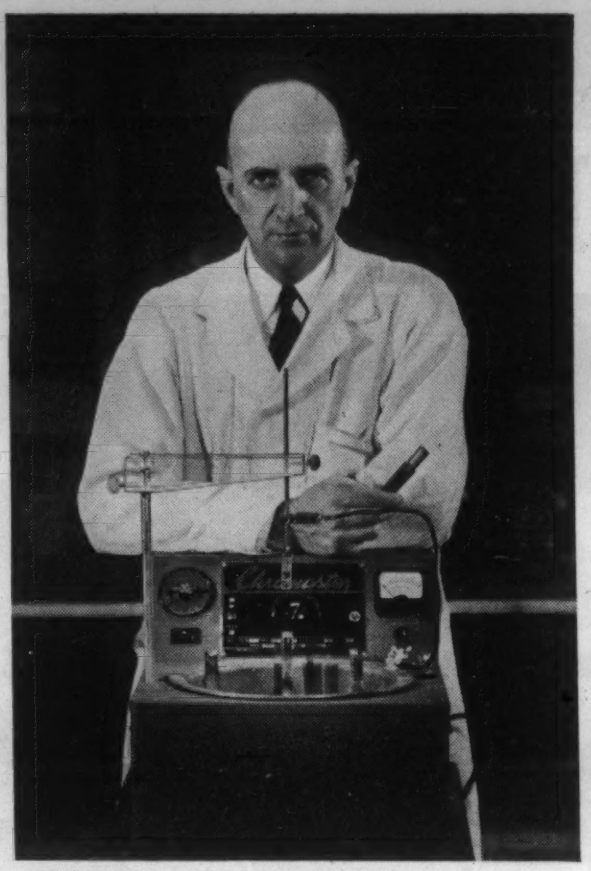
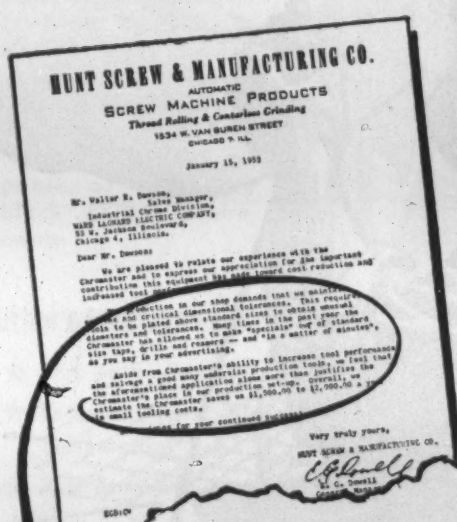
"Saves $1,500 to $2,000 in small tool costs"



Here's how one manufacturer cuts costs and increases tool performance by using a Chromaster industrial chrome plating unit right in his own plant.



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January 15, 1953

Mr. Walter E. Dowell,
Sales Manager,
Industrial Chrome Division,
WARD LEONARD ELECTRIC COMPANY,
55 W. Jackson Boulevard,
Chicago 4, Illinois.

Dear Mr. Dowell:

We are pleased to relate our experience with the Chromaster and to express our appreciation for the important contribution this equipment has made toward cost reduction and improved tool performance.

The production in our shop demands that we maintain extreme and critical dimensional tolerances. This requires tools to be plated above standard sizes to obtain unusual diameters and tolerances. Many times in the past year the Chromaster has allowed us to make 'specials' out of standard size taps, drills and reamers—and 'in a matter of minutes'. Over-all, we estimate the Chromaster saves us $1,500.00 to $2,000.00 a year in small tooling costs.

Aside from Chromaster's ability to increase tool performance and salvage a tool many materials production tools, we feel that the aforementioned application alone more than justifies the Chromaster's place in our production set-up. Overall, we estimate the Chromaster saves us $1,500.00 to $2,000.00 a year in small tooling costs.

Thanks for your continued success.

Very truly yours,
HUNT SCREW & MANUFACTURING CO.
E. G. Dowell
E. G. Dowell
General Manager

EGD:CP

"The production in our shop demands that we maintain extreme and critical dimensional tolerances. This requires tools to be plated above standard sizes to obtain unusual diameters and tolerances. Many times in the past year the Chromaster has allowed us to make 'specials' out of standard size taps, drills and reamers—and 'in a matter of minutes'. Over-all, we estimate the Chromaster saves us $1,500.00 to $2,000.00 a year in small tooling costs."

writes E. G. Dowell, General Manager,
Hunt Screw & Manufacturing Co., Chicago, Ill.

Other users are increasing their production and profits with this simple, fast, low-cost industrial chrome plating process.

A Large Automotive Axle Company Reports:
"Using a Chromasol plated tap with 3½ minutes plating, we are now averaging 6,800 holes per set of taps for banjo housings. This has more than doubled our former 3,000 holes per set of 7/16-14 high-speed commercial ground taps."

An Electric Motor Manufacturer Says:
"We have been able to correct manufacturing errors by Chromasol plating to salvage one hundred electric motor shafts otherwise rejected as undersize."

A Manufacturer of Plumbing Fixtures Says:
"Chromasol plating has increased the life of our 8-32 machine screw tap, used in tapping a plumbing fixture, from 1,000 pieces to 6,000 pieces."

A Pump Manufacturer Says:
"Our deliveries of small pumps for the oil industry have been speeded as much as five days by depositing .0002" to .0005" Chromasol plate on shafts that would otherwise have been scrapped or sent out to a commercial chrome plating company. This operation in one instance permitted a $16,000 pump unit to be put into operation immediately."

There's reason after reason for installing Chromaster in your plant. It can mean dollar savings to you in increased production, minimized set-up and down-time on your machine tool operation. Normal life of your cutting tools and wear parts can be multiplied three to ten times by this amazing new and simplified method of chrome plating. 3½ minutes for the average job. There's a size Chromaster for every shop.

Chromaster

Ward Leonard Electric Co.
Industrial Chrome Division
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Please send information on industrial chrome plating with Chromaster.

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Mica Paper . . .

Continued from page 182

mica coming from India. In case of war, enemy action could make transportation of mica from India hazardous, and imported mica would not be obtainable in adequate supply. Mica paper, on the other hand, can be made from domestic mica. Mica paper could make up for the loss of India mica in most of our micaceous insulation.

This article was adapted from a paper presented before the National Academy of Science and the American Institute of Electrical Engineering.

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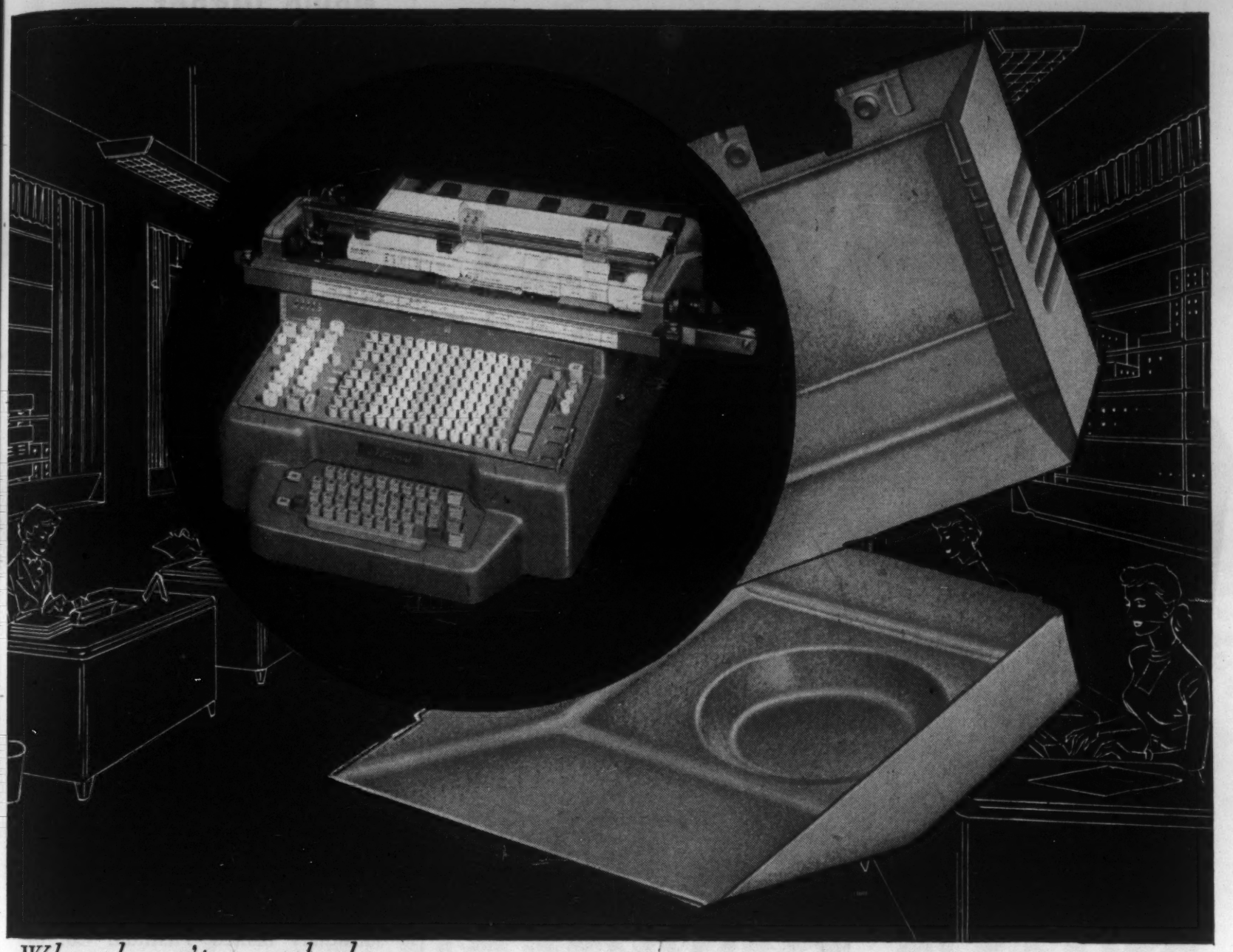

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Somebody does! With a remarkable new plastic material—Vibrin polyester resin. Look what it's done for one of the products of the National Cash Register Company.

Used for several housing parts on their Class "31" Accounting Machines, this glass-fiber-reinforced Vibrin* gives far superior sound-deadening effects. And what an unusual combination of lightness and toughness! These handsome molded pieces have all the ruggedness, the oil and shock resistance to take the hardest use for as long as the machine lives.

These Vibrin parts not only did the job — they did it better than the material previously used! To National Cash Register, as to other great manufacturing leaders, Vibrin has provided the basic material on which important product progress is being built.

Versatile Vibrin is just another example of Naugatuck's ingenuity and imagination at work, solving old problems, creating new products. Chances are Naugatuck Chemical can help you to a better product. Why not send us the coupon below?

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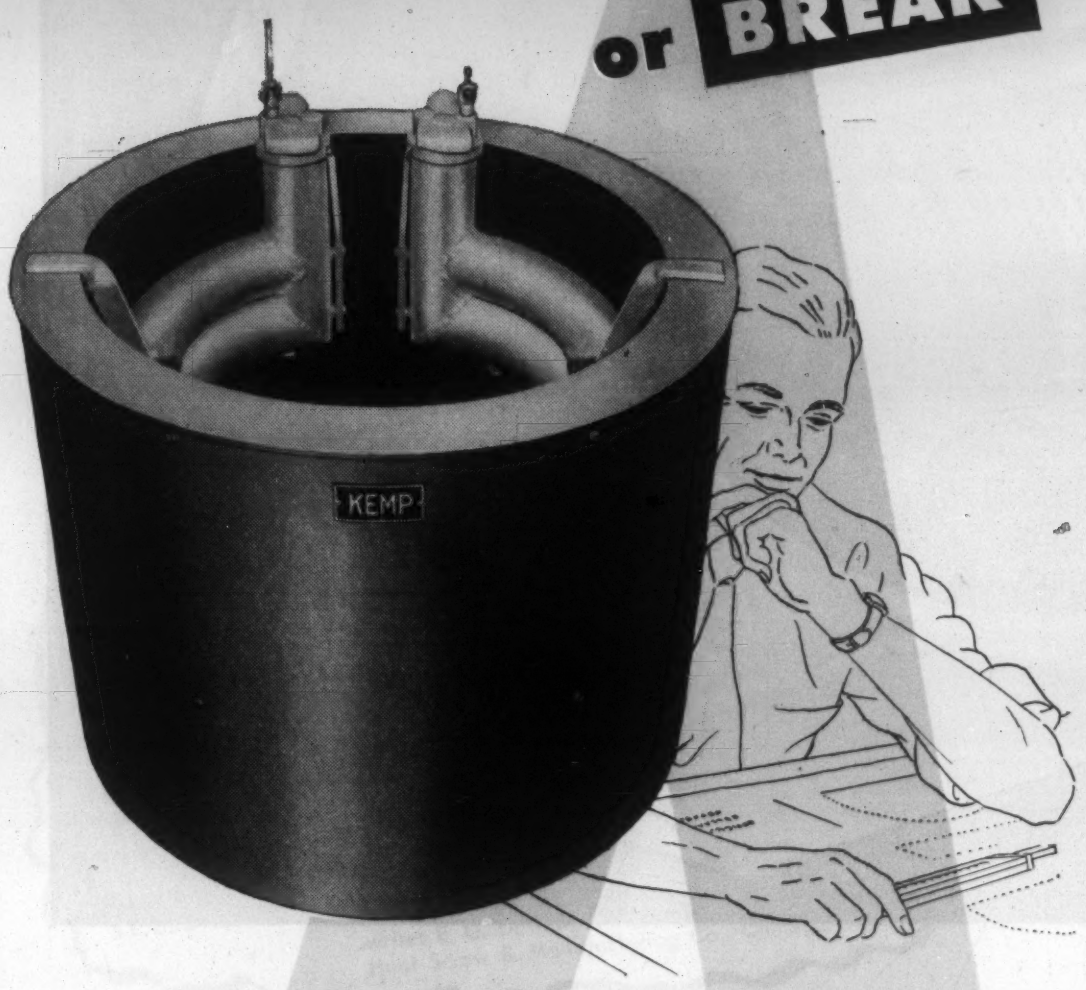

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News Digest

continued from page 13

The supersonic wind was developed by E. F. Fullam, one of the company's scientists.

The contrivance is utilized primarily for cutting extremely thin cross-section specimens of materials for study under an electronic microscope. Although a knife blade is used, its principal purpose is to produce a small pocket of compressed air which immediately precedes the blade.

Dr. Fullam believes the air does the actual cutting of the device, known as a microtome. The knife blade is propelled at 1200 ft a sec, or 818 miles an hr. The speed of sound is about 750 miles an hr.

The Cristiansen Corp., Chicago producer of aluminum and magnesium alloy ingot and other products for the foundry, has announced the formation of a wholly-owned subsidiary named Titanium Co. of America. This corporation plans the construction of facilities for the manufacture of wrought products for industrial and military markets from titanium.

Critical Defense Materials Saved by Signal Corps

A research and development program aimed at conservation of critical materials, instituted since World War II, is beginning to pay dividends, the Army Signal Corps has announced.

Although the Signal Corps is a comparatively small user of such critical items as steel, copper, nickel, aluminum and rubber, substantial savings in these materials have been realized already and further benefits from the program are anticipated.

New, light weight field wire, used for battlefield communication lines, is now in production. It is smaller in diameter than its World War II counterpart and uses no rubber at

A solvent emulsion cleaner - SC-2-E is outstanding in its field. It has found wide application as the precleaner for buffing compounds on non-ferrous metals when followed by further stages of spray or soak cleaning. Currently SC-2-E has demonstrated its value in removing lapping compounds and Magnaflux powders in one and two stage washers . . . The physical and chemical action of this bath will produce clean smut-free surfaces under difficult service. Wide and rapid acceptance speaks for its efficiency and value. SC-2-E can be used on *all* metals . . . Send for information, a 24 page brochure describes all NORTHWEST products

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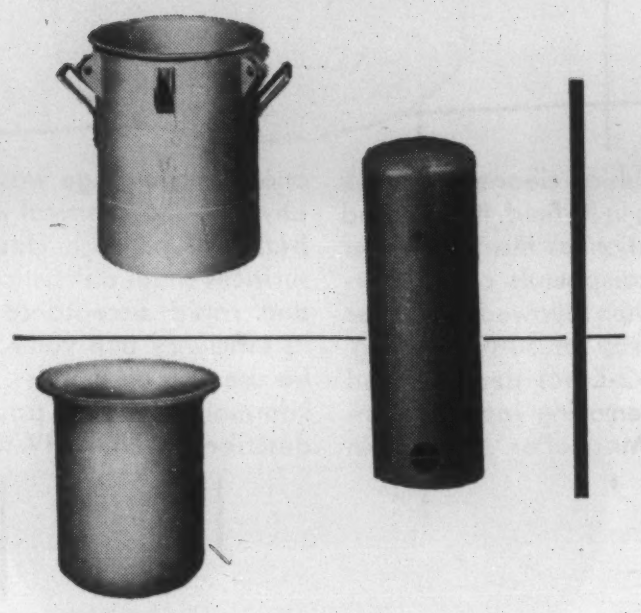

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News Digest

all, resulting in a monthly saving of some 30,000 lb of copper and 400 tons of rubber. Under the current producing program, the reduced size of the new wire, coupled with the fact that some of it is packed in newly-designed canvas containers, means a saving of about 3500 tons of steel per year in the manufacture of wire reels.

The new walkie-talkie radio, about one-half the size and weight of its predecessor, is expected to reduce yearly Signal Corps requirements for steel by 225 tons, copper by 45 tons, and quartz by 2500 lb.

A new 12-line switchboard, less than one-third the weight of the earlier type, will save about 225 tons of steel, 33 tons of aluminum, 2250 lb of beryllium copper, and 7500 lb of stainless steel each year.

Better packaging methods and careful salvage have resulted in other savings. Changes in packaging specifications for field wire will save some $4,000,000 yearly in plywood, aluminum foil, and other packaging materials.

Return, reconditioning, and reissue of reels for field wire is expected to result in reclamation of 3500 tons of reels from Europe and another 3500 tons from the Far East.

A method of recovering industrial diamond wheels in Signal Corps shops is saving about $25,000 per year.

The Steel Founders' Society of America observed its 5th anniversary in April. One of the oldest national trade and technical organizations in America, the Society has performed a vital role through the last 50 years of progress in the steel casting industry.

Behavior of Metals Reported on in Latest NACA Publications

The National Advisory Committee for Aeronautics has recently issued reports on a number of research projects of interest to materials en-

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STRESSPROOF® WORKS WHERE OTHER STEELS FAIL

STRESSPROOF was selected for this transmission pinion gear for the Norge washing machine—made by NORGE Division of Borg-Warner Corporation.

● This washing machine pinion must run for years without appreciable wear. After extensive field tests, Norge engineers found that STRESSPROOF works where other steels fail. Even heat-treated alloy, at double the cost per part, does not equal STRESSPROOF.

Then too, STRESSPROOF is used as machined. No heat treating means no distortion, with the consequent noisy operation of the washing machine. The pinions made of STRESSPROOF are clean and free of scale and require no clean-up work. They are ready for assembly as they come off the machines.

STRESSPROOF makes a better part at lower cost.

Wear resistance is only one of the four in-the-bar qualities that makes STRESSPROOF the choice for thousands of parts. *High strength*, double that of ordinary cold-finished shafting; *Machinability*, fully 50% better than heat-treated alloys of the same strength; and *Minimum warpage* in machining—are three other attributes of this unique steel.

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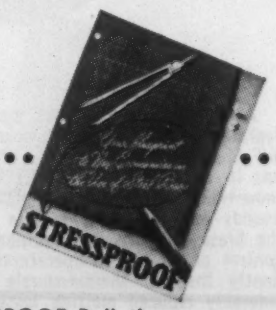

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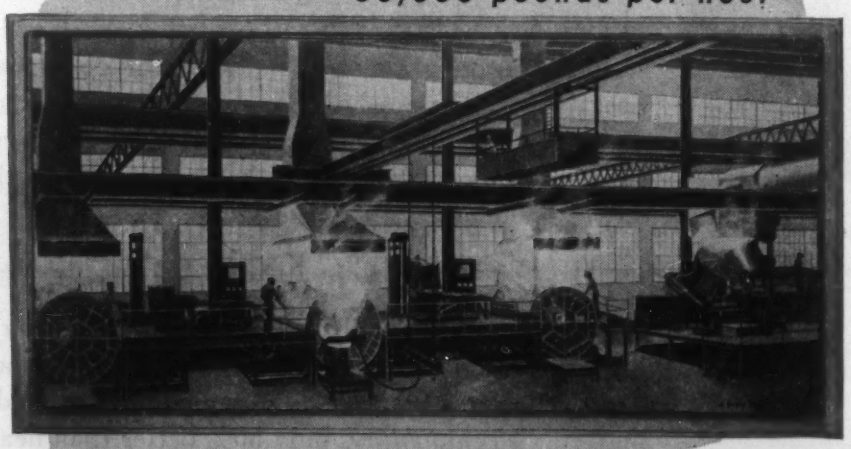

-and five men
do it all

AJAX INDUCTION FURNACES

In operation at the Waterbury, Conn. plant of the Scovill Manufacturing Co.

As a part of the most modern and completely integrated brass cold rolling operation in the world, Scovill Manufacturing Company of Waterbury, Connecticut, has in operation three 1000 kW. Ajax-Scomet electric induction melting furnaces with a production of 10,000 pounds each per hour. These furnaces, the largest in the brass industry, are equipped with the most precise control of melting temperatures by means of a permanently inserted thermo-couple and have thereby considerably reduced melting losses.

Every half hour each of these furnaces in turn discharges its 5,000-pound charge into a ladle which is transferred by crane to a holding furnace (shown at right) of 9,000 pounds capacity. This furnace is mounted over the continuous casting machine located on the floors below, and thus is able to provide a permanent flow of molten brass to the mold. The intermixing of the charges from the three furnaces gives additional uniformity of composition.

WRITE FOR FURTHER DETAILS ABOUT AJAX FURNACES

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News Digest

gineers. The titles, authors and abstracts of these include:

Creep Tests on Some Cast Magnesium Alloys. Part I, II and III. A. E. Johnson and H. J. Tapsell. (ARC R & M 2675; ARC 8281; ARC 8306. Formerly ARC 7595; ARC A.459) Results of creep tests of 150-hr duration at 212, 302 and 392 F on some heat treated sand cast magnesium alloys are presented. A comparison of the creep properties of three cast magnesium alloys based on tests of 1000-hr duration is made. Finally, results are presented of short-time creep tests at 3 tons per sq in. of four cast magnesium alloys having different heat treatments.

Corrosion of Magnesium Alloy ZK60A in Marine Atmosphere and Tidewater. Fred M. Reinhart, National Bureau of Standards. (NACA TN 2632) The corrosion resistance of unprotected magnesium-zinc-zirconium alloy ZK60A was determined in a marine atmosphere and in tidewater. The unprotected alloy was so rapidly attacked in tidewater that it would be of no practical value in applications subject to wetting by sea water. In the marine atmosphere, the rate of corrosion was much less and the alloy should give good service if adequately protected.

Fatigue Strengths of Aircraft Materials. Axial-Load Fatigue Tests on Notched Sheet Specimens of 24S-T3 and 75S-T6 Aluminum Alloys and of SAE 4130 Steel with Stress-Concentration Factor of 1.5. H. J. Grover, W. S. Hyler and L. R. Jackson, Battelle Memorial Institute. (NACA TN 2639) Results are given of axial-load fatigue tests on notched specimens of 24S-T3 and 75S-T6 aluminum alloys and of normalized SAE 4130 steel. Each specimen was notched by edge notches designed to have a theoretical stress-concentration factor of 1.5. Tests were run at nominal mean stresses of 0, 10,000, 20,000 and 30,000 psi. Results extend previously reported data on unnotched specimens, and specimens more severly notched afford data on the variation of fatigue strength reduction with notch severity.

Friction and Surface Damage of Several Corrosion Resistant Materials. Marshall B. Peterson and Robert L. Johnson. (NACA RM E51L20) Friction and surface damage of several materials that are

HOLES

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Whenever your work involves punching holes in hard-to-get-at or irregularly spaced locations—there's another place where Hannifin "Hy-Power" Hydraulics can help you. This portable equipment with its variety of work tools can bring forces up to 100 tons (more in multiple) to the work as needed.

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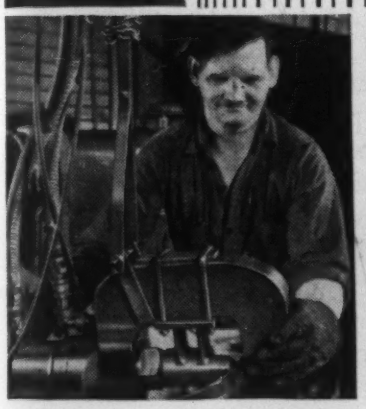
But "Hy-Power" Hydraulics are not limited to riveting. The basic high pressure "Hy-Power" generator and portable work tools are widely adapted for punching, forming, bending.



"Hy-Power" *portable punching on furnace radiator shell.*

"Hy-Power" *portable riveting on an assembly operation.*

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Hard and strong enough to take the constant pounding of heavy shock loads and high compressive forces, these Promet Bronzes are also sufficiently high in lead content, soft enough, to prevent seizure and to embed harder particles that would ordinarily result in scoring. Easily machined at high speeds without lubricants or coolants.

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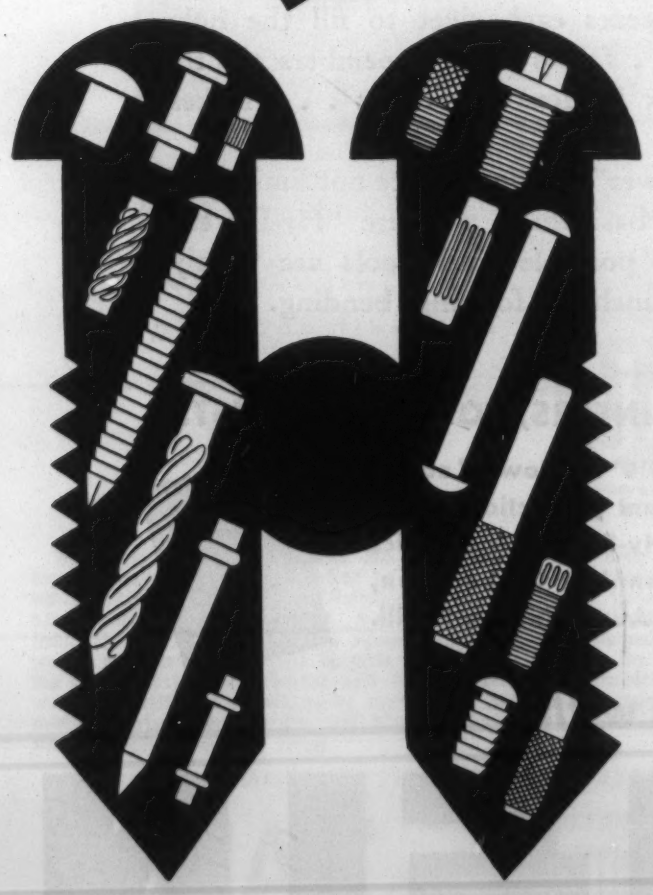

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News Digest

resistant to corrosion due to liquid metals was studied in air. The values of kinetic friction coefficient at low sliding velocities and photomicrographs of surface damage were obtained. Appreciable surface damage was evident for all materials tested. The friction coefficients for the combinations of steel, stainless steel, and monel sliding against steel, stainless steel, nickel, Inconel and Nichrome ranged from 0.55 for the monel-Inconel combination, to 0.97 for the stainless-steel-nickel combination; for steel, stainless steel, monel and tungsten carbide against zirconium, the friction coefficient was approximately 0.47. Lower coefficients of friction (0.20 to 0.60) and negligible surface failure at light loads were obtained with tungsten carbide when used in combination with various plate materials.

Survey of the Chromium-Cobalt-Nickel Phase Diagram at 1200 C. W. D. Manly and Paul A. Beck, University of Notre Dame (NACA TN 2602) A survey of the chromium-cobalt-nickel ternary phase diagram at 1200 C was made by means of microscopic and x-ray diffraction studies on 110 vacuum melted alloys prepared from commercial metals of the highest purity available. At 1200 C, the following phases occur: (1) very extensive face centered cubic solid solutions, based on the binary cobalt-nickel solid solutions; (2) body-centered cubic chromium-base solid solutions; and (3) brittle sigma-solid solutions, based on the chromium-cobalt sigma phase which is isomorphous with the iron-chromium sigma phase.

Survey of Portions of the Cobalt-Chromium-Iron-Nickel Quaternary System. E. L. Kamen and Paul A. Beck. (NACA TN 2603) An isothermal survey was made of certain portions of the chromium-cobalt-nickel-iron quaternary system at 1200 C. The iron content was varied up to 30% to include the range of commercial chromium-cobalt-nickel alloys. The component cobalt-chromium-iron ternary system was also studied.

Creep in Metals. A. D. Schwope, F. R. Shober and L. R. Jackson, Battelle Memorial Institute (NACA TN 2618) This report covers phases of an investigation of the fundamentals of creep in metals. Results of a study of creep in single crystals of high-purity aluminum are pre-

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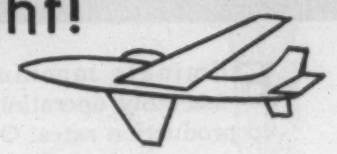

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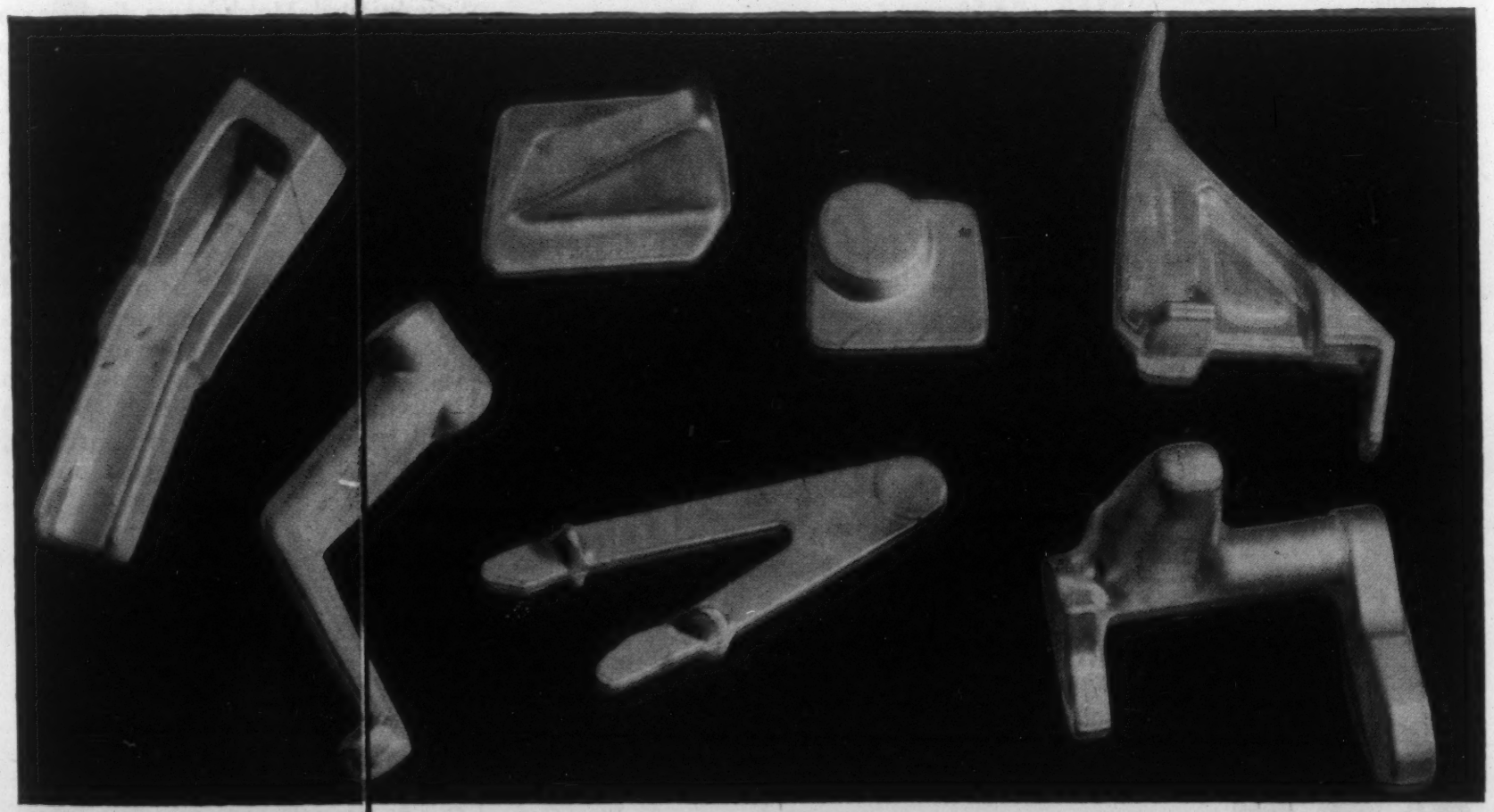

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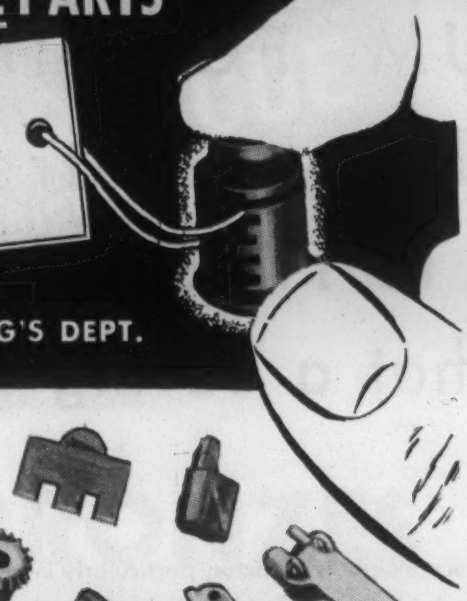

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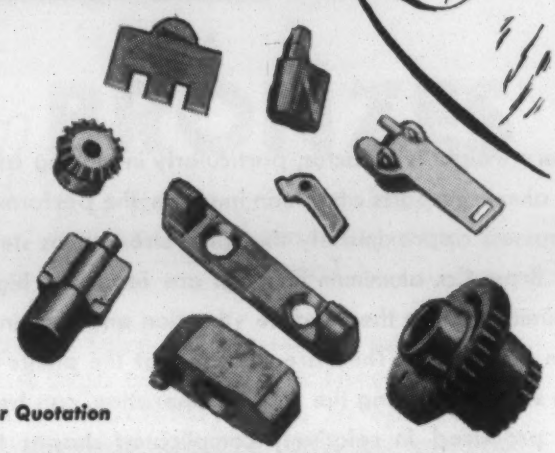

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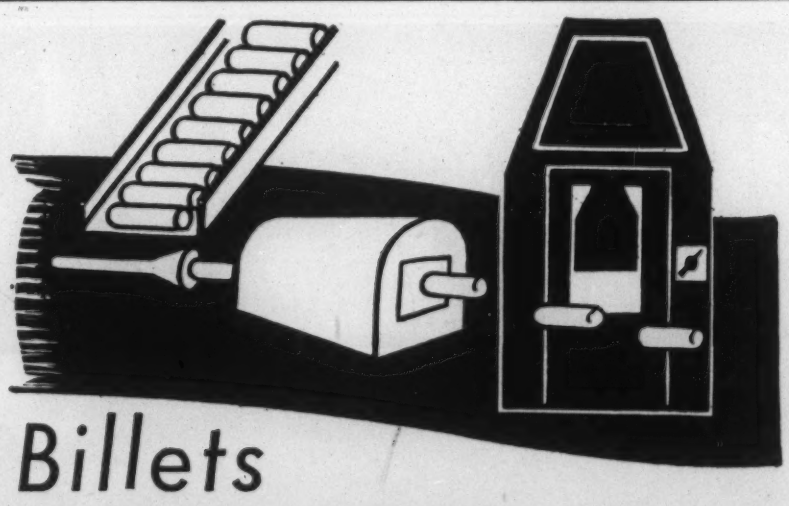

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141-S

News Digest

sented and discussed. It is shown that at low stresses the creep phenomenon appears to be consistent with Mott and Nabarro's theory of exhaustion creep, while at higher stresses results appear to be more in accord with ideas expressed by Andrade.

Bonding of Molybdenum Disulfide to Various Materials to Form a Solid Lubricating Film. I—The Bonding Mechanism. Douglas Godfrey and Edmond E. Bisson. (NACA TN 2628) The use of molybdenum disulfide as a solid film lubricant in applications where designs or temperatures preclude liquid lubricants is dependent upon successful bonding to the surface. An experimental investigation was conducted to determine the basic mechanism of bonding and extend application of the bonding to a variety of materials. When molybdenum disulfide was applied to a surface as a mixture of powder and some liquid vehicles, the liquid vehicle decomposed and polymerized to a resin which bound the particles together and to the surface to be lubricated. Molybdenum disulfide can be bonded by resin-forming viscous liquid vehicles, such as asphalt- and silicone-base varnishes, glycerine, ethylene glycol, polyglycol ether and corn syrup to a variety of materials, such as steel, aluminum, brass, stainless steel and glass. The reduction of Fe_2O_3, formed by preheating steel in air to Fe_3O_4 by one of the liquid vehicles (syrup) improves the frictional properties of the solid lubricating film. Rubbing molybdenum disulfide, whether dusted, built-up or bonded by a resin to a surface, produced distinct preferred orientation.

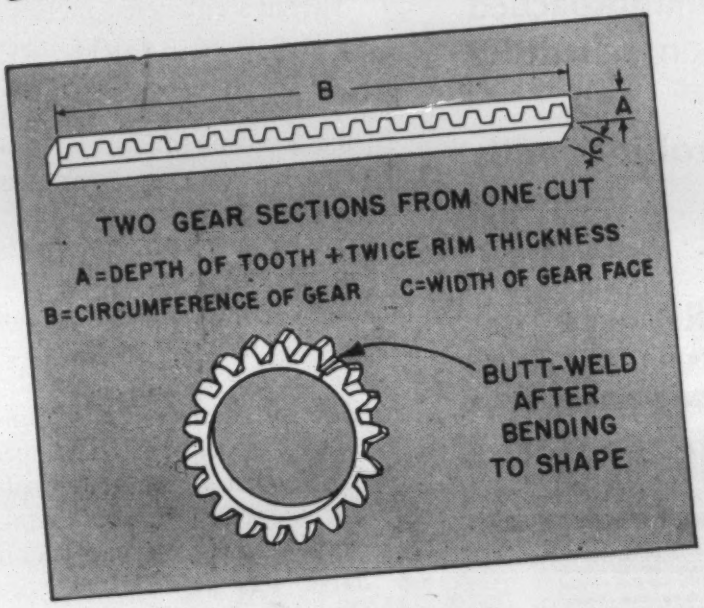
Radioisotope Study of Porcelain-Enamel Adherence

A ceramic or porcelain-enamel coating, to be effective, must adhere to the metal it is designed to protect. Cobalt oxide effectively promotes adherence of porcelain enamel to iron, and for this reason has long been added to enamel ground coats. Despite a great deal of research, however, the mechanisms by which

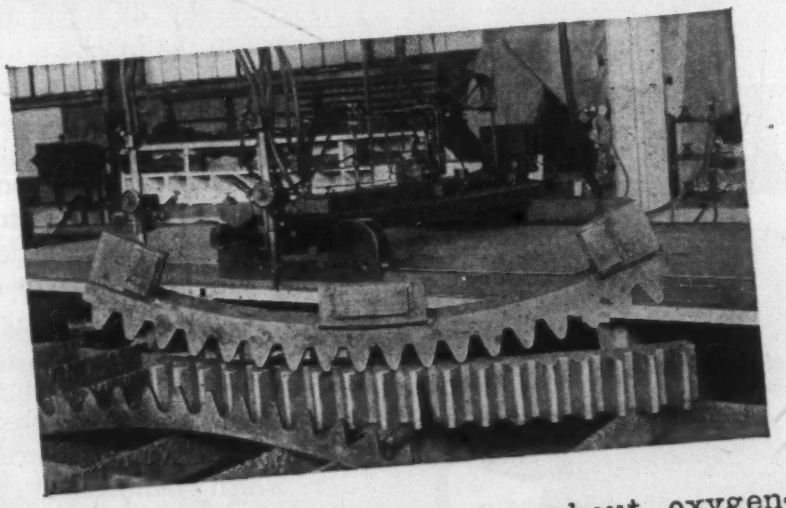
Ideas on Welded Design—For the Engineer's Notebook

DON'T OVERDESIGN

Careful consideration of allowable tolerances often results in reduced costs through elimination of overdesigned parts. Precision gears, for example, are an unwarranted expense where more economical gears that are accurate within 1/64 inch will give just as satisfactory service.

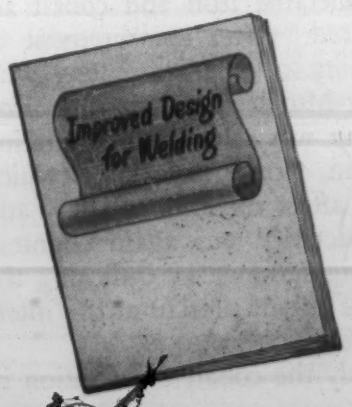


Such gears, for farm machinery, cement mixers, and similar equipment are produced by oxygen-cutting and welding as shown in the sketch. One cut makes two gear sections. There is no scrap loss. Welded circular sections require further finishing only in weld areas.



Eight steel sections like this, oxygen-cut from 5-in. thick slabs, are welded together to make 14-ft. diameter gears for pontoon cranes. Maximum tolerance is only 1/32 in., but no machining is required.

For further information about oxygen-cutting, welding and other cost reducing LINDE methods, phone or write LINDE AIR PRODUCTS COMPANY, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N.Y. Offices in Other Principal Cities. In Canada: Dominion Oxygen Company, Limited, Toronto.



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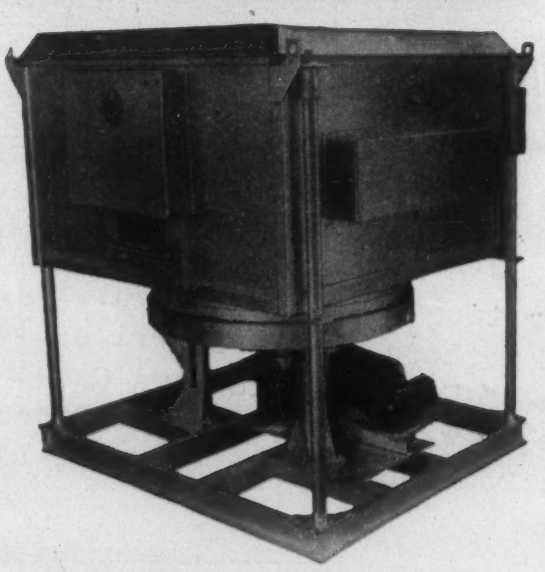

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cobalt oxide promotes adherence are not well understood.

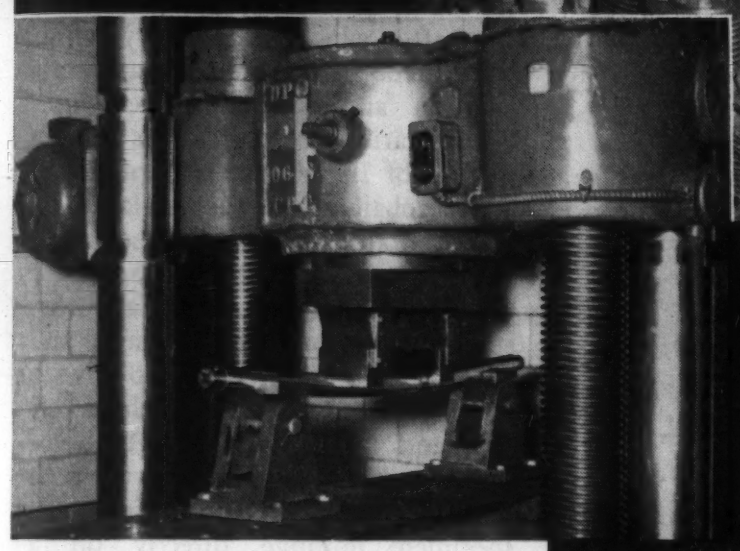
Using very sensitive radioisotope tracer techniques, the National Bureau of Standards has recently obtained new information on this important problem. The NBS study, conducted by W. N. Harrison, J. C. Richmond and associates of the Bureau's enameled metals laboratory, was part of a broad investigation—sponsored by the National Advisory Committee for Aeronautics—of the mechanisms involved in the adherence of porcelain-enamel and ceramic coatings.

Conventional porcelain-enamel ground coats usually contain at least eight components. In addition to cobalt oxide, oxides of iron and nickel are usually present. Studying the distribution of radioactivity in coated specimens after firing, NBS found that a metallic cobalt layer was formed at the enamel-metal interface, and that near the interface the enamel layer was depleted in cobalt oxide. The amount of cobalt that thus migrated to the interface increased with increased firing, though the total quantity was extremely small—equivalent to a layer of metallic cobalt of the order of 0.01 micron (about 0.4 millionths of an in.) thick for normal firing. The cobalt deposit apparently did not penetrate into the enameling-iron base during normal firing.

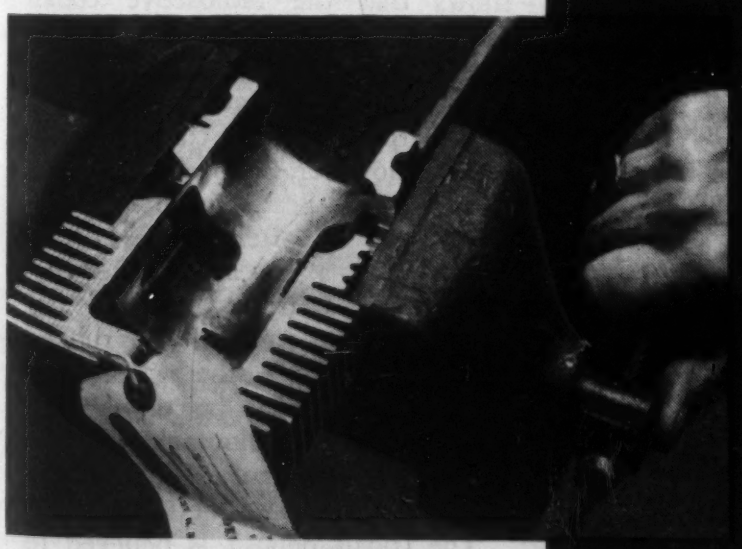
In the NBS investigation, small specimens of 18-gage enameling iron were coated with a porcelain enamel to which radioactive cobalt oxide had been added. After either underfiring (4 min at 1450 F), normal firing (4 min at 1575 F), or overfiring (6 min at 1750 F), the specimens were de-enameled with molten sodium hydroxide. Under the conditions of the experiment the sodium hydroxide readily dissolves the enamel and partially dissolves the iron oxides present at the interface, but the metallic iron and cobalt are not affected. After measurement of radioactivity of the specimens with a Geiger-Muller counter, the iron oxide layer was removed by agitation in sodium citrate solution (which does not affect metallic cobalt), and the radioactivity was again counted. These measurements indicate the amount of cobalt present at the interface in metallic form.

To study the cobalt distribution in

PORUS-KROME on Aluminum



This 75ST aircraft oleo piston plated with Van der Horst chrome withstood repeated bending under increasing loads, without destroying the bond, until the base metal itself failed.



After long use, this aluminum cylinder was cut in half and squeezed in a vise until the casting failed, without causing the PORUS-KROME to fracture at the bond line.

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the enamel layer itself, specimens were ground through from one side until almost all of the iron was removed. Treatment with a solution of iodine in potassium iodide removed the rest of the iron and also the metallic cobalt layer, leaving only a thin shell consisting of the iron oxide and enamel layers. The radioactivity of the resulting solution was checked for an indication of the amount of metallic cobalt at the interface, and radioactivity counts were made on each side of the chips of enamel. The iron oxide at the enamel-metal interface was then removed by solution in ammonium citrate, after which radioactivity counts were made of the ammonium citrate solution and again of the chips. These various measurements give a picture of the distribution of radioactive cobalt in the enamel layer.

To obtain a picture of the cobalt distribution near the interface by a different technique, a normally-fired specimen was mounted in plastic and ground at a slight angle to give a large-scale section through the interface and into the metal. An autoradiograph of the section was then made by letting radiation from the specimen impinge directly on a photographic film that was in contact with the specimen. Like the other observations, the autoradiograph shows that the radioactive cobalt concentrated at the interface but did not penetrate the metal.

Substantial penetration of the iron base by the radioactive cobalt was observed, however, in a coated specimen that was heated in air at 1300 F for 270 hr after normal firing. When such a specimen, after de-enameling, was treated with the ammonium citrate solution and rubbed with a damp cloth, the radioactivity count was reduced by only about 10%. An autoradiograph likewise showed considerable radioactivity below the surface of the iron.

The cobalt deposit is believed to be metallic because it is removed with the iron-base metal during the iodine-potassium-iodide treatment, but is not completely removed by 65 hr of treatment with ammonium citrate. The NBS experiments performed so far do not indicate whether the cobalt deposit consists of the pure metal or of an alloy with iron, nickel, or both. This may be clarified in future phases of the investigation.

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Technical Reports Offer New Data to Aid Metallurgical Industries

New techniques of interest to the metallurgical industries are described in the current issue of the Bibliography of Technical Reports, published by the Office of Technical Services, Department of Commerce. Especially important are developments in high temperature alloys, improved steels and better turbine blades. The reports in these subjects are described briefly below.

Investigation of the Fundamental Factors Promoting High-Temperature Strength of Alloys, Battelle Memorial Institute. A study of the effects of nitrogen, iron and nickel additions upon the alpha-beta transformation, and the precipitation of gamma in cobalt-chromium alloys containing approximately 20 and 32% chromium, is described.

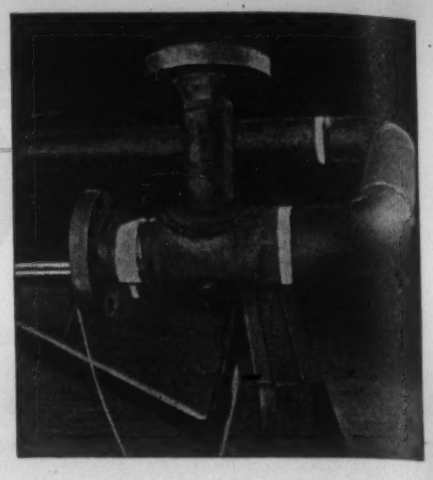
Past Work on Fatigue of Metals in the High Temperature Field, Illinois University. A review of the principal concepts of the high temperature fatigue behavior of metals, obtained from laboratory investigations.

Stress Rupture Tests on Sheet Alloys for High Temperature Applications, U. S. Air Material Command. Stress-rupture tests at 1500 F were conducted on six alloys of different bases and on eight stainless steel modifications, all in sheet form.

Alloys for High Temperature Service, Battelle Memorial Institute. In the program to improve the room temperature stock resistance of chromium-base alloys, 35 heats were prepared to study the effects of several variables.

Alloys for High Temperature Service, Battelle Memorial Institute. In the investigation of chromium-base alloys, the effects of variations in melting and casting practices, chemical composition and heat treatment on room-temperature shock resistance are being studied. Sixty heats have been prepared and tested in bending.

Effects of Some Solution Treatments Followed by an Aging Treatment on the Life of Small Cast Gas-Turbine Blades of a Cobalt-Chromium Base Alloy and *Effect of Selected Combinations of Soaking Time, Temperature and Cooling Rate,* U. S. National Advisory Committee for Aeronautics. An investiga-



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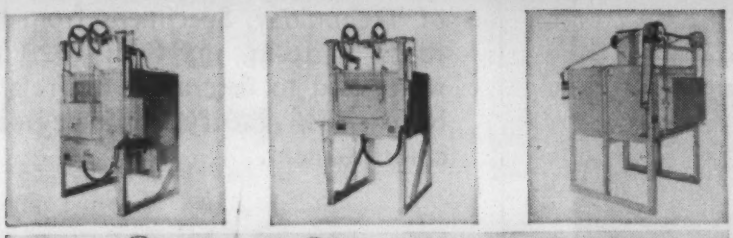

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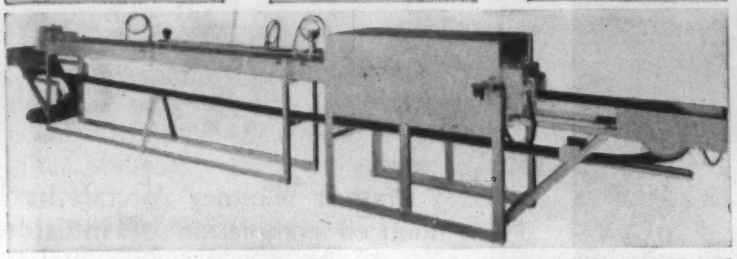

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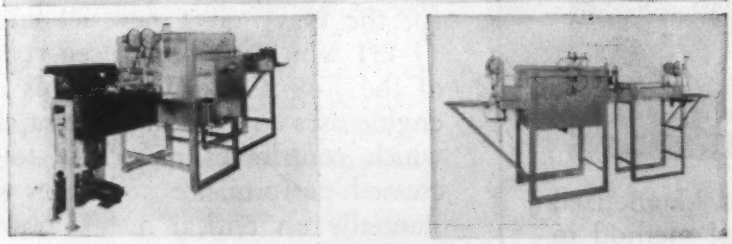

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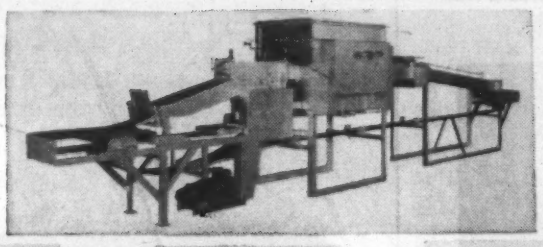

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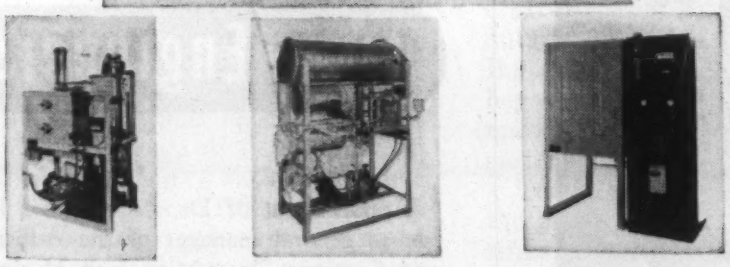

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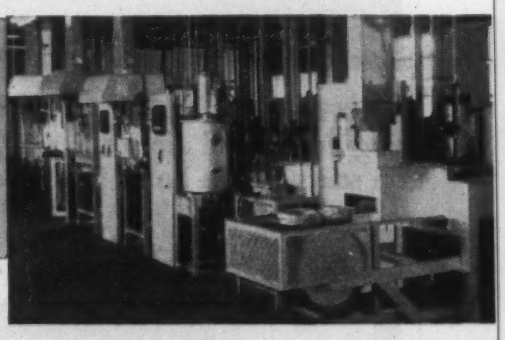

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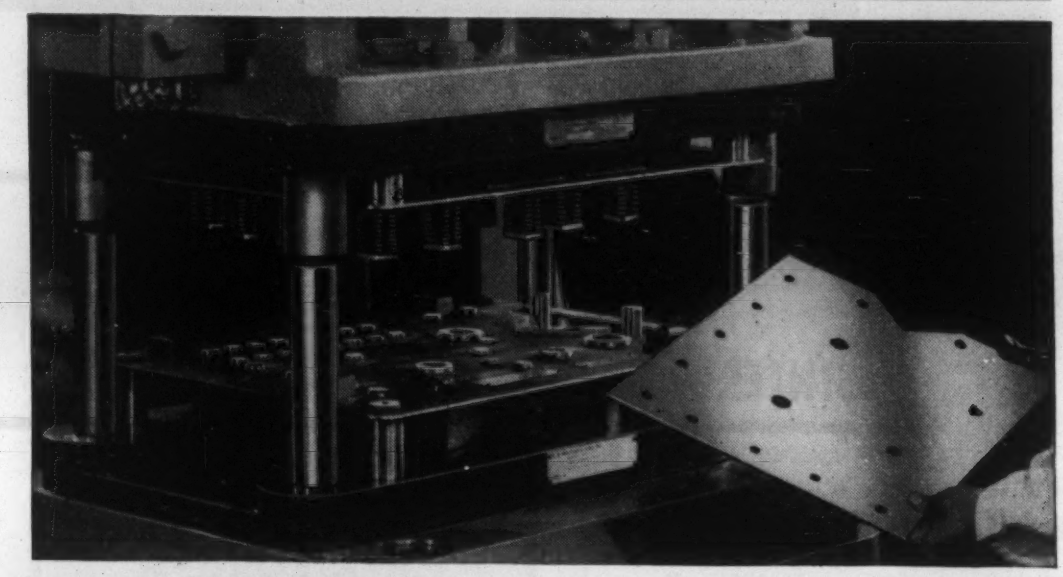
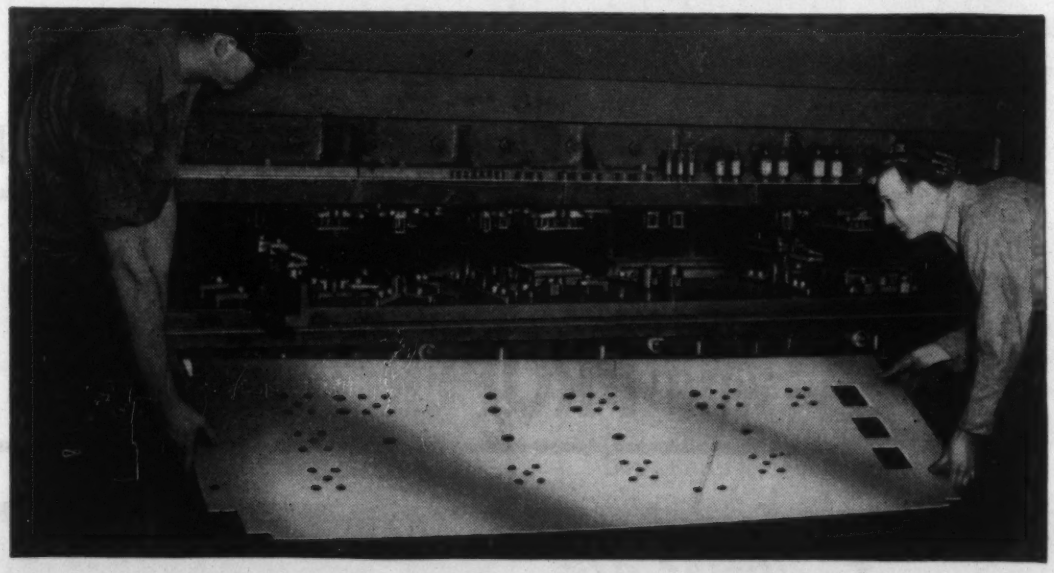
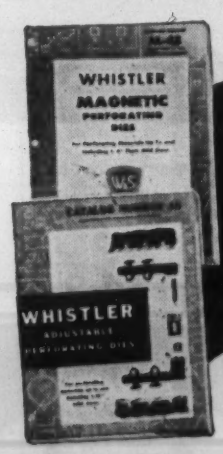


Whistler *MAGNETIC* Dies at work in large inclinable press. Magnetized units hold the retainers. No bolting required. A fast, economical method in making up a punch and die set for short or long runs. All parts re-usable.



Whistler *ADJUSTABLE* Dies on ⅛" steel perforating and notching job, using Tee slotted die set. With Whistler Adjustable Punch and Die units production starts within hours instead of weeks. Last minute job changes made quickly.



Here are the complete details with prices and application illustrations. Send for these catalogs. No obligation.

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News Digest

tion was conducted to determine the effects of a number of solution and aging treatments on the life of small cast gas-turbine blades of Haynes Stellite Alloy 21.

Hydrogen Embrittlement of SAE 1020 Steel, Massachusetts Institute of Technology. Specimens from hot-rolled 7/16-in. dia SAE 1020 rod were used to determine the relation between H content and the degree of embrittlement.

Pratt & Whitney Aircraft has announced completion of initial tests for the Navy on a new jet engine (J-48) which is an advanced version of the J-48 Turbo-Wasp. This new engine uses a new heat resistant alloy which contributes materially to increased performance and saves substantially on critical metals now in short supply.

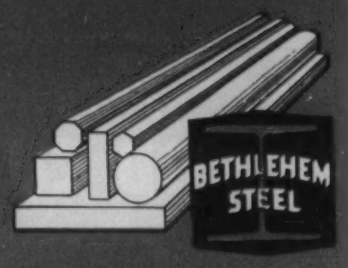
News of Engineers

Appointment of Dr. *Charles W. Walton* as general manager of the Adhesives and Coatings Div., Minnesota Mining & Manufacturing Co., has been announced by the company. Dr. Walton replaces *Louis F. Weyand*, who was recently made executive vice president in charge of all 3M tape operations. Appointment of three general managers to head the tape divisions was also announced. *C. C. Smith* will head the Cellophane Tape Div.; *William E. Zimmerman* was named general manager of the Industrial Tapes Div.; and *Bernard W. Lueck* was made general manager of the Masking Tapes Div.

Three executives of Aluminum Co. of America have been elected to newly created vice presidencies, according to a recent company announcement. *Gordon W. Cameron* was named vice president and treasurer; *Arthur P. Hall* was elected vice president in charge of public relations and advertising; *C. F. Nagel, Jr.,* chief metallurgist, assumes the third vice presidential post.

Six organizational changes in the de-

Tool Steel Topics



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Users Pick A-H5 in Survey of Air-Hardening Steels

Several years ago we had to make up our minds whether we were going to continue to promote the 2 pct chromium type of air-hardening tool steel or the newer 5 pct chromium type. Both are general-purpose die steels. In other words, plenty of wear-resistance is a must — plus sufficient shock-resistance for cold work.

The big question was to decide which was more important — the lower annealed hardness and easier machining of A-H5 (the 5 pct chromium steel) or the lower quenching temperature of the 2 pct chromium type.

We made an investigation among major users of tool steel, heat-treaters, and others. And here's what we found they wanted most, in order of importance:

1. Maximum wear
2. Minimum distortion in heat-treatment
3. Easy machining
4. Adequate shock-resistance
5. Low quenching temperature

It was a clear-cut vote for A-H5. And when the question of shock-resistance was discussed, they agreed, "If it's a shock job, then use a regular shock tool steel like Bethlehem Omega or 67 Chisel."

Our decision to carry rather complete stocks of A-H5 has been fully justified by the swing to the 5 pct chrome grade. We've watched A-H5 reach a new high in popularity for jobs that call for safe hardening, very little distortion, and high wear-resistance.

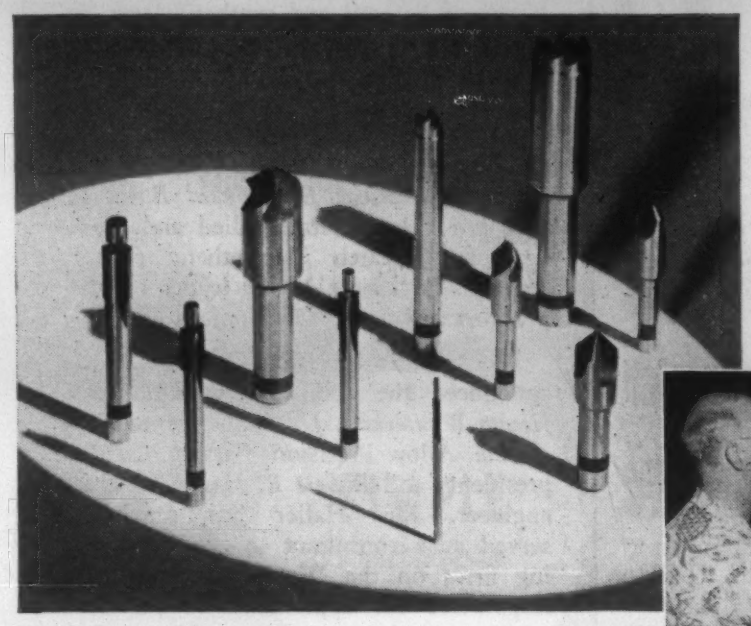
Users say:

". . . Never had such fine service from dies."

"Don't know what it is to have cracked dies any more."

". . . I've cut my costs on grinding and stoning many times since using A-H5."

Edges stay sharp on this trimmer die of A-H5 which removes ragged metal from sheet-steel parts.



These precision cutting tools are made from Bethlehem 66HS, our moly-tungsten high-speed steel. The CTC trademark appears in the undercut bands on the shank of each tool.

Final dimensions are checked on a main rotor balance stand for use by several helicopter manufacturers. Built by Custom Tool, this special fixture has a tip made of Bethlehem 67 Chisel tool steel.

Custom Tools made from Standard Tool Steels

It takes a variety of Bethlehem tool steels to meet the needs of Custom Tool Co., North Hollywood, Calif. Makers of special tools, especially those required in aircraft repair and assembly, this firm is the outgrowth of a home workshop where Ben Sprague, president of the company, began to make his own special tools to make the overhauling of aircraft an easier job.

Today the CTC trademark appears in the black band on the shank of countersinks, counterbores, hollow mills, special wrenches, fixtures and jigs. Quality steel and careful heat-treatment go hand in hand with the precision machining of tools made to close tolerances.

Here's a fine example of how many tool and die jobs are handled by standard tool steels. The CTC cutting tools are ordinarily made from Bethlehem Special HS, our standard 18-4-1 type of high-speed steel. But tungsten conservation measures now require the use of our moly-tungsten steel, Bethlehem 66HS.

Tools subject to heavy shock or impact loads are made either from Omega, our silico-manganese tool steel, or 67 Chisel, the chrome-tungsten type.

BTR, our manganese oil-hardening tool steel, was used recently by Custom Tool in a new series of screw gages which have been designed to set up standards for aircraft fasteners.

Our Tool Steel Engineer Says: Use extra care in quenching large sections of carbon tool steel

Large tools made of carbon tool steel can be cracked very easily during quenching. A quench which only partially hardens a tool made of carbon tool steel is more likely to cause cracking than a quench which produces full hardening.

A quench which produces soft spots in the chill of carbon tool steel can cause cracking which is violent enough to be classed as an explosion — the tool may literally break up into a number of pieces.

Ineffective quenching which causes soft spots may result from:

Use of fresh water containing dissolved air . . . use of water contaminated by soap, oil, etc. . . . insufficient quantity of quenching solution . . . inadequate agitation in the quench.

A drastic quench in brine which produces a uniform chill is necessary to avoid cracking large tools when they're made from carbon tool steel.

Bethlehem ULTRASONIC TESTED **Tool Steel**

Precision ROD CUTTING

at high speed with the new di-acro

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The DI-ACRO Rod Parters further increase the applications of "DIE-LESS DUPLICATING" as a cost cutting, time-saving production technique.

Do you require precision? — DI-ACRO Rod Parters hold tolerance to .001" on duplicated cuts. The ends are square, and roundness is maintained.

Do you want speed?—The Rod Parters exceed outputs of other methods with equal accuracy, on rods and bars up to 5/8". Torrington Roller bearings incorporated in an exclusive multiple leverage arrangement provide remarkable ease of operation.

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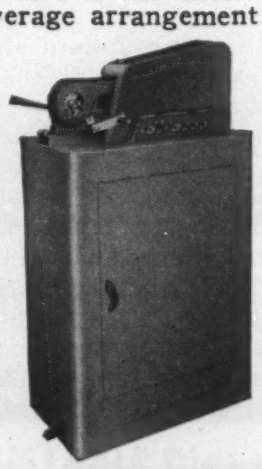

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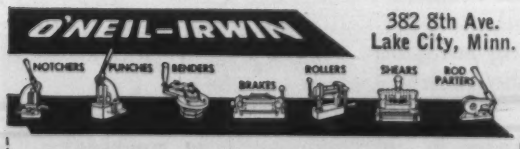

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News Digest

velopment department of Naugatuck Chemical Div., U. S. Rubber Co., have been announced as follows: Dr. *Vadim C. Neklutin*, assistant manager of process development; *Robert M. Greene*, group leader of Paracril and synthetic latex development in the process development section; *Robert L. Knapp*, group leader of Vibrin and Kralac development in the same section; Dr. *William F. Brucksch, Jr.*, senior group leader for physical chemical research; *E. Leonard Borg*, senior group leader for applied and developmental research in synthetic rubber; *John A. Flickinger*, group leader for dispersions and Sealz development.

Pennsylvania Precision Casting Co. has announced the following appointments: *Hiram Winternitz, Jr.*, formerly president of the Alloy Precision Casting Co., as president; and *Robert R. Haller*, as chief engineer. Mr. Haller has previously served as a consultant to precision casting firms on the West Coast, and was responsible for application of precision casting techniques to waveguide production.

According to an announcement from Powdered Metal Products Corp. of America, the following men were elected to the office of vice president: *Carl G. Levin, M. W. Isaacson* and *C. Chandler Cole*.

Scott H. Patterson has been appointed branch manager of The American Brass Co.'s Buffalo, N. Y. plant.

Ward A. Wickwire, Jr. has been elected president of Salem-Brosius, Inc.

A. R. Booker, formerly executive vice president and general manager of Electrofilm Corp., has been elected president of the company.

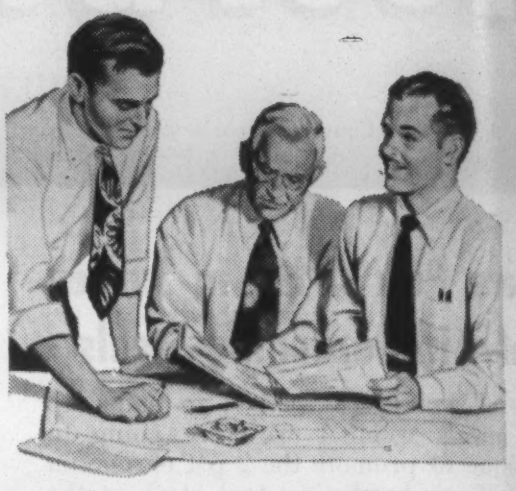
The appointments of *Arthur R. Lytle* as director of research, *Walter Crafts* as associate director of research, and *David Swan* as assistant director of research of Union Carbide and Carbon Research Laboratories, Inc., have been announced.

David L. Henry has joined the Research Laboratory staff of Metal Hydrides, Inc. as an assistant research chemist.

The appointment of *Merle F. Schreurs* as manager of the new Coating Research and Development Laboratory at Industrial Ovens, Inc. has been announced. Mr. Schreurs was formerly project engineer for the Vinyl Dispersions Div. of the Research and Development Laboratory of Textileather. Also announced by the company was the appointment of *John F. Allen* as manager of the Allen Extrusion Machinery Div. of the company.

Reginald James Seymour Pigott, director of the Engineering Div., Gulf Research and Development Co., has been named recipient of the Egleston Medal

A PRACTICAL SOLUTION TO THE



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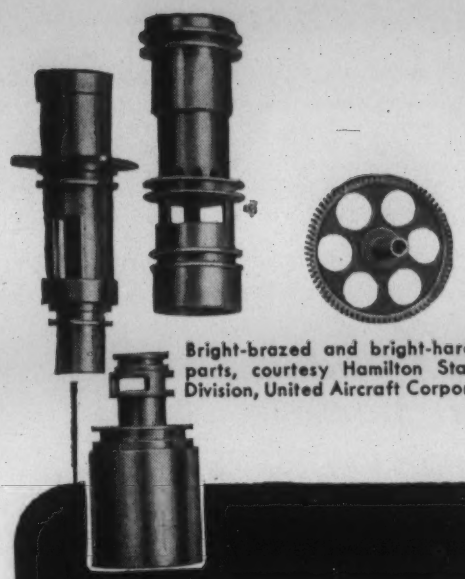

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No pickling, sand blasting or tumbling required. These costly operations are eliminated, so your parts retain their sharp design and edges. A special Sargeant & Wilbur alloy for bright-brazing makes the joint practically invisible because it resists dulling and matches the metal color perfectly. Steel and non-ferrous metal parts are brazed in the same operation with excellent results.

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News Digest

for 1952, an award for distinguished engineering achievement. The Medal, first presented in 1939, is awarded yearly by Columbia University's Engineering Alumni Association.

Appointment of *Alva L. Cremean* as vice president in charge of manufacturing, The Bunting Brass and Bronze Co., has been announced.

R. G. Tabors has been appointed general manager of the Aircraft Turbine Dept., Eddystone Div., Baldwin-Lima-Hamilton Corp. This assignment is in addition to his activities as manager of the Hydraulic Press and Power Tool Dept.

Lee Fraser has been made production manager of Arma Corp.

Two new vice presidents of Solar Aircraft Co. have been elected. *Leon T. Noel*, formerly comptroller, was elected vice president and comptroller, and *Herbert Kunzel*, secretary, was elected vice president and secretary.

Hiland G. Batcheller, chairman of the board of the Allegheny Ludlum Steel Corp., has been named a member of the Industrial Council recently organized at Rensselaer Polytechnic Institute. *Arthur H. Bunker*, president, Climax Molybdenum Co., has also been named a member of the Council.

Robert C. Gibbons, formerly assistant chief metallurgical engineer, Eclipse-Pioneer Div., Bendix Aviation, has been transferred to the Utica Div. of the company as chief metallurgist.

C. H. Foulkrod has been appointed works manager, Quaker Rubber Corp., according to a recent announcement. Also announced was the election of *George A. Dauphinais* as vice president and general manager.

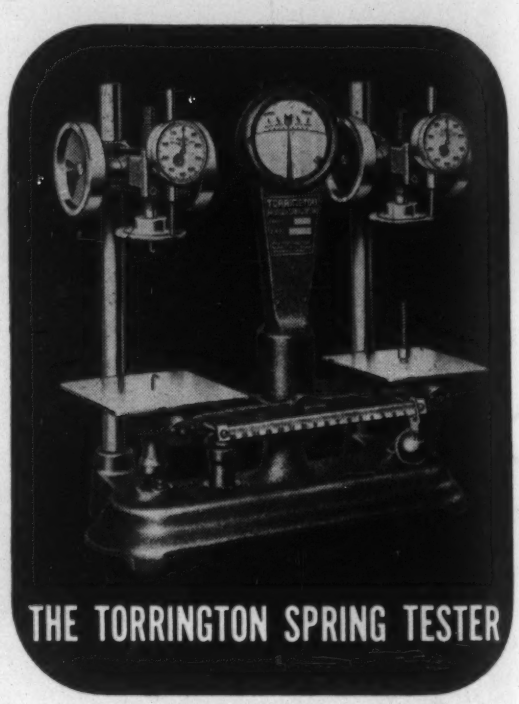
Lester O. Pfahl has joined Hooker Electrochemical Co. as a mechanical engineer in the Operations Dept. The following appointments were also announced: *Wilma M. Vogt* as chemist in the Development and Research Dept.; *Orville R. Hicks* as draftsman in the Engineering Dept.; *Frank L. Echelberger* as chemist in the Works Laboratory; and *Brantford H. Dietrich* as a plant engineer.

I. Melville Stein, executive vice president, Leeds & Northrup Co., has been elevated to the grade of Fellow by the American Society of Mechanical Engineers.

O. A. Wheelon, production design engineer of Douglas Aircraft Co., has been awarded the Wright Brothers Medal by the Society of Automotive Engineers. Mr. Wheelon was given the award for his published analysis of problems involved in using titanium in airplane design and construction.

The Twin Disc Clutch Co. has an-

NOW...Spring Makers and Spring Users alike have a Uniform Method for Testing Springs!



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Simple: can be used at operating levels by relatively inexperienced personnel. Portable!

Accurate: 2 models — the 3 pound model measures loads to the nearest 1/100 ounce, and the 16 pound model to the nearest 1/5 ounce; lengths and deflections to 1/1000 inch.

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"Gears of cold rolled steel treated with **HARD-N-TUFF** are proving superior to high carbon steel gears."

triple life of tools and parts,

"By using **HARD-N-TUFF,** we substituted free-cutting steel treated with **HARD-N-TUFF** for expensive molybdenum steel in making punches."

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Today . . . send for HARD-N-TUFF Idea Book, which reveals how this revolutionary steel hardening compound helps manufacturing companies everywhere solve their tool and part hardening problems. HARD-N-TUFF provides fast, effective 3-way action . . . carburizing, nitriding, chromizing. What's more, it's easy to use . . . merely heat the part, dip or roll in the compound. HARD-N-TUFF is non-toxic, and can be used on all types of tools, drills, dies, cams, bits—wherever maximum toughness and wear resistance are required. Get the facts and you'll put HARD-N-TUFF to the test right away. Don't forget—HARD-N-TUFF is unconditionally guaranteed to increase tool life at least 300%. Use it for production, maintenance and emergency jobs.

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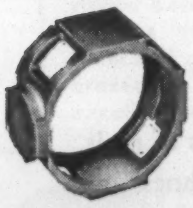

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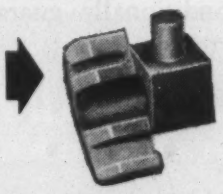

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News Digest

nounced the appointment of *Donald E. Beaton* as assistant general manager, Hydraulic Div.

David E. Cordier and Dr. *Harold A. Hoppens* have been advanced to the posts of director of research and director of technical service respectively, of the Plaskon Div., Libbey-Owens-Ford Glass Co. Both men were formerly associate directors of research.

S. R. Bell has been appointed principal engineer on synthetic resins and plastics of the Chemical Plants Div., Blaw-Knox Co.

Edwin H. Keiper has been named chief engineer of the Pennsylvania Crusher Co.

According to a recent announcement from Storts Welding Co., *Stephen M. Martin* has been appointed mechanical engineer. Mr. Martin was formerly chief engineer of United Chromium, Inc.

Industrial Nucleonics Corp. has appointed *D. G. Calkins* to direct the activities of the research staff in developing new applications of atomic power for industry.

At a recent directors' meeting of the Graton & Knight Co., *David S. Williams* was elected president of the company, succeeding his father, *Arthur A. Williams* who is chairman of the board.

R. H. Kitzman, vice president and manager of the Toledo plants of the Doehler-Jarvis Corp., has been appointed general production manager for the company.

Following a recent meeting of the Ford Motor Co.'s board of directors, it was announced that *Harold T. Youngren*, vice president-engineering, was retiring. *Earle S. MacPherson*, chief engineer of the company's engineering staff, will succeed Mr. Youngren.

W. E. Massey has been elected president of Weldit, Inc.

Wilbur H. Norton, vice president, General Motors, has been named president and member of the board of R. M. Hollingshead Corp.

John E. Spears, control manager of the Gas and Coke Div., Koppers Co., Inc., has been named assistant general manager of the division.

Several organization changes have been announced by Chain Belt Co. *W. J. Sparling* has been appointed to the newly created position of vice president and manager of Milwaukee operations. He will have executive responsibility for the major divisions. *M. G. Jewett* has been appointed manager, Chain & Power Transmission Div. *B. F. Devine*, vice president and manager of the Construction Machinery Div., will become a staff officer of the company; *A. K. Thomas* has been named manager, Construction Machinery Div., and *J. W. Lendved* has been appointed director of engineering, Construction Machinery Div.

Lawrence M. Limbach, formerly mana-

154 ideas on ways to use . . .

154 varied applications of molybdenum sulfide in the shop and in the field are described in a new booklet now available. This solid-film lubricant has demonstrated unique anti-friction properties under conditions of extreme pressure, high velocity, elevated temperature, or chemical attack.

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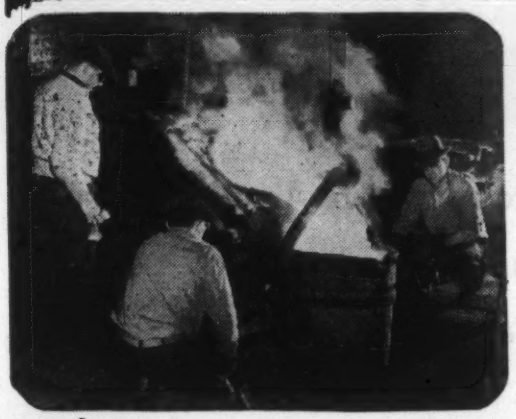

Scientific schools and groups of designers, engineers, metallurgists and technical societies can *now* secure the *free* use of this full-color sound film, the first produced in the steel foundry industry. Available in 16 mm prints, the film is a 37-minute tour of the modern plant of Lebanon Steel Foundry. The camera follows jobs from the blueprints on the project engineer's desk through steps of production to show, finally, a few of the many important uses of Lebanon quality Steel Castings. Write for information on this exciting and educational film.

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LEBANON
ALLOY AND STEEL
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News Digest

ger of operations, Steel and Tubes Div., Republic Steel Corp., has been appointed works manager of The Ryan Aeronautical Co.

Robert F. Huntly has been elected president of Cowles Chemical Co. Mr. Huntly succeeds *Edwin Cowles*, who continues as a director.

Announcement has been made that *Ralph S. Howe*, executive vice president, The New Britain Machine Co., will take over the duties of director of the Metalworking Equipment Div., The National Production Authority. Mr. Howe succeeds *Swan E. Bergstrom*, vice president, Cincinnati Milling Machine Co., who has held this position for the past year.

Dr. *William L. Meggers* of the National Bureau of Standards has received the first annual award of the Society for Applied Spectroscopy for outstanding contributions to the science of spectroscopy.

Elevation of Dr. *I. A. Oehler*, director of metallurgy and research at the American Welding & Manufacturing Co., to new responsibilities in the company's overall management has been announced. Mr. Oehler, who will continue to direct the company's research activities, assumes the newly created post of administrative assistant to the executive vice president.

F. Guy White, technical director, Granite City Steel Co., has received the annual award of the Galvanizers Committee. The presentation of a bronze plaque marked the award to Mr. White in recognition of his distinguished service to the Committee and to the galvanizing industry.

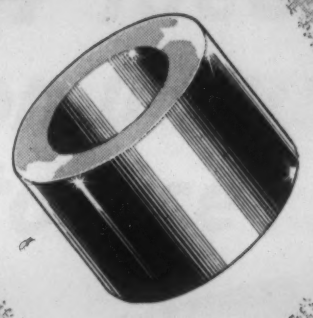
Horizons Inc. has announced the appointment of Dr. *A. Taylor* as a project supervisor in its Physics Dept. in Cleveland.

James V. Lester, controller of the Standard Pressed Steel Co., was elected treasurer at the company's recent annual meeting.

Eleven Dravo Corp. employees have been presented with cash awards totalling $1200 for their winning entries in the Pittsburgh company's 13th annual Technical Papers Contest. First prize of $500 went to *E. P. Swatek*, chief design engineer of the Contracting Div. for his paper, while the second prize of $300 was awarded *G. H. Atwood*, chief engineer of the Crane and Bridge Dept. *A. J. Liebmann*, research engineer, took third prize of $100 for his paper on surface preparation science for industry and research. Awards of $50 each were made to the following: *A. J. Dawson, Charles W. Granacher, E. M. Hays, William S. Major.* Awards of $25 were received by: *Richard D. Darrah, George F. Wolfe, F. J. Larkin* and *John W. Long.*

Arthur P. Davis is back from an early retirement to serve as president of Arma

WORKS WHERE OTHERS WON'T



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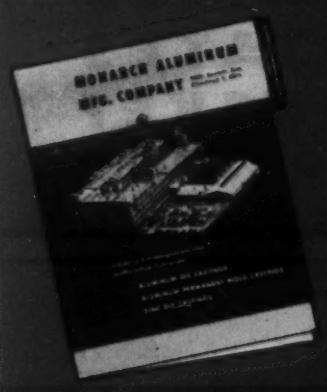

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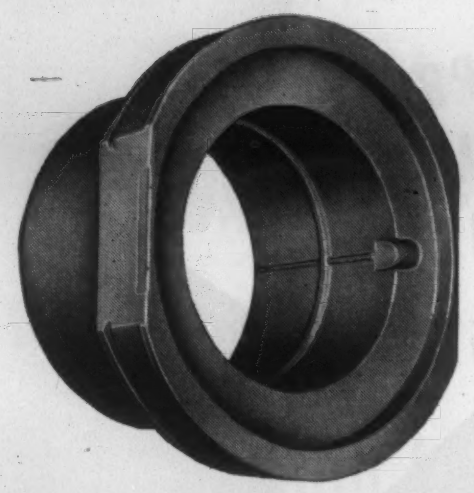

Precision Investment Casting can solve many difficult internal machining problems such as putting in 3/64" ribs shown in the above part. This piece weighs ¾ of a pound, measures 2¾ inches in overall diameter and is cast in 410 stainless steel. Inside diameter is held to plus or minus .005".

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News Digest

Corp., subsidiary of American Bosch Corp.

George T. Collins has been elected assistant to the president, Pennsylvania Salt Manufacturing Co.

E. G. Hirtle has been named chief engineer of the Richmond Div., Gar Wood Industries, Inc.

Two Eastman Kodak Co. men received high honors from the American Society of Lubrication Engineers at the Society's annual meeting. They are: *Paul J. Galbreath,* who received the Society's highest award, the Alfred E. Hunt Memorial Medal, for authorship of the outstanding technical paper published in the Society's journal last year. *Cort L. Miller* gained the first annual Hodson Award for the best technical paper published by a young engineer. The company has also announced the retirement of *Irving C. Matthews*, who headed the service section in the Chemistry Div. of the company's Research Laboratories.

Leslie Touluse has been appointed plant manager of the Chrysler Corp.'s Amplex plant. Also announced by the company is the retirement of *H. R. Matheny*, vice president and general manager of the Highland Park plant.

Louis K. Buell has recently joined American-Marietta Co. as chief chemist in charge of research and development in the New Coatings Div.

The election of *George V. Slottman* as vice president of Air Reduction Co., Inc. has been announced.

Two men have been appointed to new positions in the Engineering Dept. of United Chromium, Inc. *Walter S. Cibulskis* has been named chief of engineering and *Frederick G. Bauer* has been made manager of engineering.

Dr. *James A. Stavolakis*, technical engineer for General Electric Co., has been appointed a supervisor in the Ceramic and Minerals Dept. at Armour Research Foundation of Illinois Institute of Technology. Another appointment announced by the Institute was that of *William A. Casler,* assistant director of research, who has been named manager of program development at the Foundation.

Retirement of *Emmet D. Griffin* as vice president in charge of Pittsburgh Plate Glass Co.'s Paint Div. has been announced. *E. D. Peck*, general paint manager of the Merchandising Div., has been elected to succeed Mr. Griffin. Appointment of *William C. Van Clief, Jr.* as manager of the company's new power driven brush factory at Baltimore has also been announced.

Appointment of *E. C. Webb* to vice president in charge of production and engineering for Iron Fireman Manufacturing Co. has been announced. Mr. Webb previously held the office of vice president in

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PROFIT from our broad experience and greater "know-how," and our completely modern specialized facilities for rapid, low-cost production.

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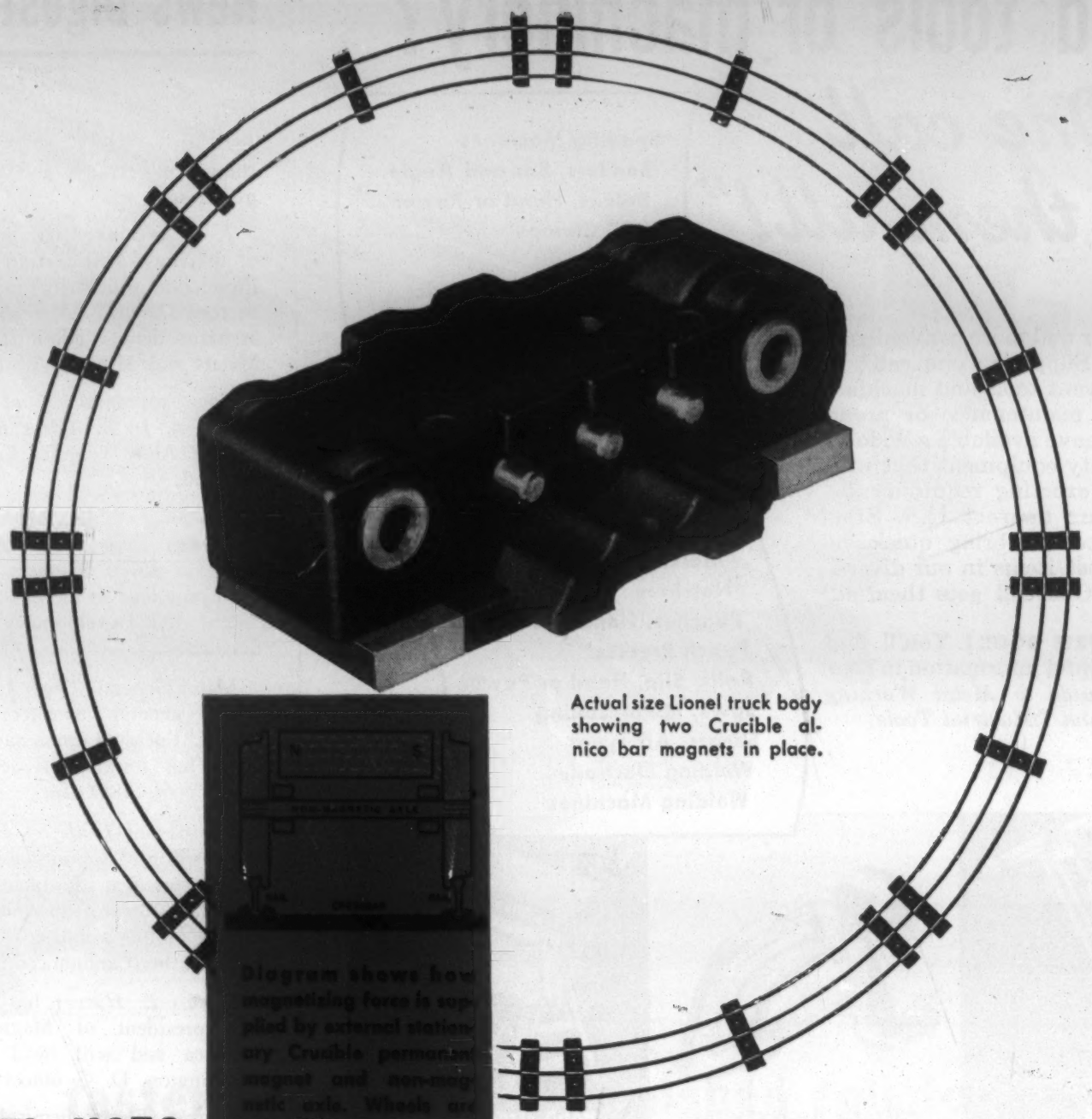

Actual size Lionel truck body showing two Crucible alnico bar magnets in place.

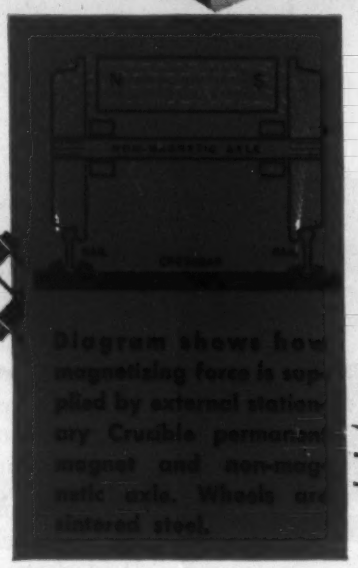

Diagram shows how magnetizing force is supplied by external stationary Crucible permanent magnet and non-magnetic axle. Wheels are sintered steel.

LIONEL USES CRUCIBLE ALNICO IN NEW LOCOMOTIVE DESIGN

The Lionel Corporation, big name electrical toy manufacturer, has pioneered in the design of miniature locomotives for table-top railroading. One of the principal aims of this design is to achieve the highest possible degree of adhesion between the driving wheels and the track.

Lionel experimented with a conventional method of increasing the traction (i.e. load up the driving axles with ballast weights) . . . and then turned to magnetic materials.

Crucible alnico specialists were called in. Working in close cooperation with Lionel engineers, the Lionel "Magne-Traction" locomotive was born. As the name implies, "Magne-Traction" utilizes magnetic attraction between powerful Crucible alnico bar magnets placed in close proximity with the wheels. By varying the number and strength of the magnets, almost any desired degree of adhesion can be obtained.

Crucible's part was twofold. Not only were Crucible metallurgists and engineers active in the initial design, but Crucible production experts precision cast these bar magnets using plastic patterns. This is an innovation in alnico magnet mass production. Commonly, alnico is made in sand molds, and usually requires a great deal of finishing, but with precision-cast alnico magnets expensive machining is cut to a minimum.

Engineering Service Available — Your permanent magnet problem will receive the same experienced consideration from Crucible's unsurpassed staff of metallurgists and production specialists. Please give full details. Crucible Steel Company of America, General Sales Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

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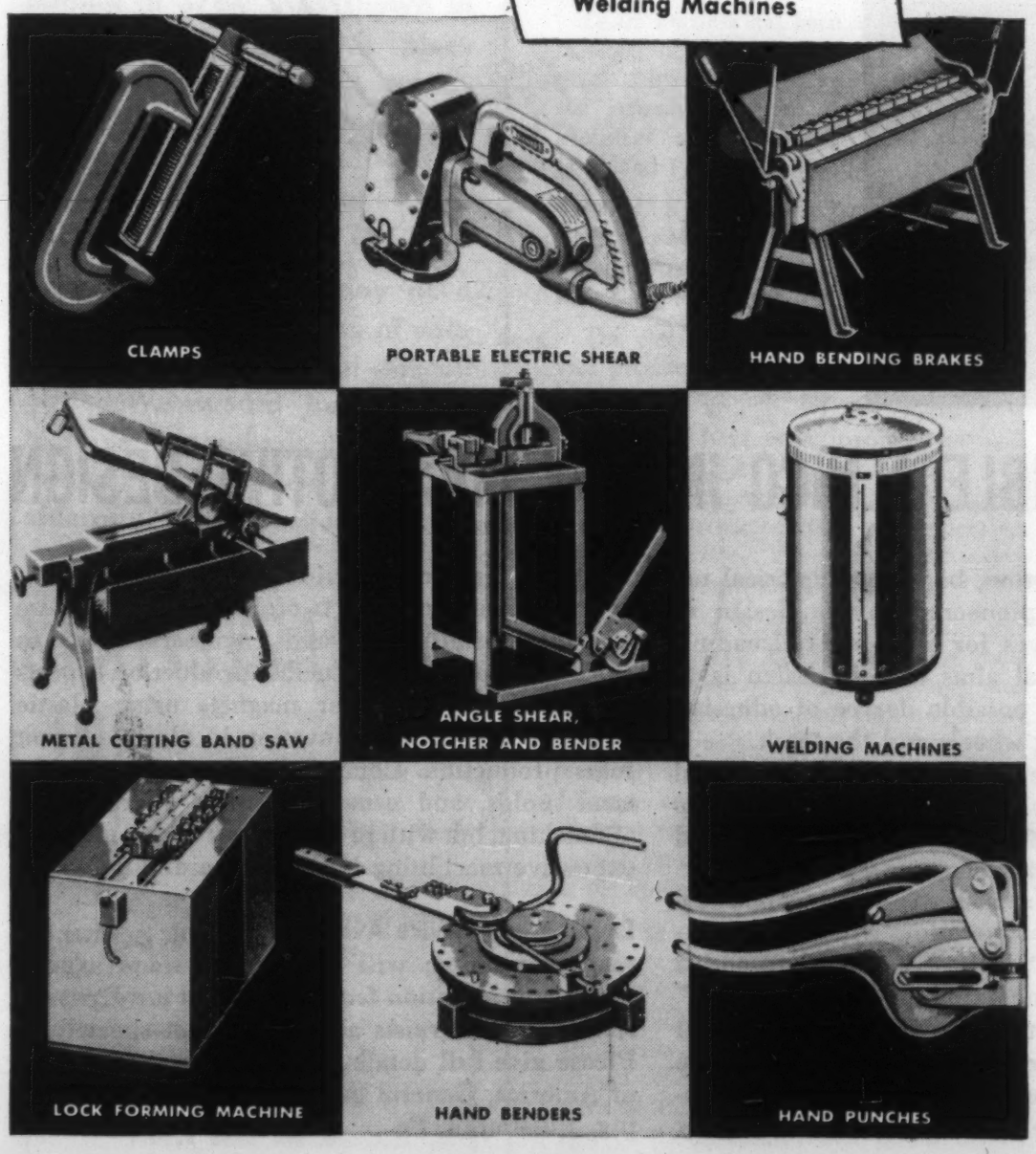
Notchers
Punches, Hand or Power
Punch Presses
Rolls, Slip, Hand or Power
Saws, Metal Cutting
Shears, All Types
Welding Electrodes
Welding Machines



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UNITED STATES STEEL

News Digest

charge of research and development engineering.

J. V. O'Connor has been named chief of the Brass Mill Section of the National Production Authority's Copper Div., to succeed *David T. Marvel,* recently named assistant deputy administrator of NPA's Metals and Minerals Bureau.

The appointment of *Wendell P. McKown, Jr.* as works manager for the Cooper Alloy Foundry Co. has been announced.

Edward J. Helm, technical engineer in the Sales Dept., Engineering and Construction Div., Koppers Co., Inc., has been promoted to the position of manager, Patent and Development Section of the division.

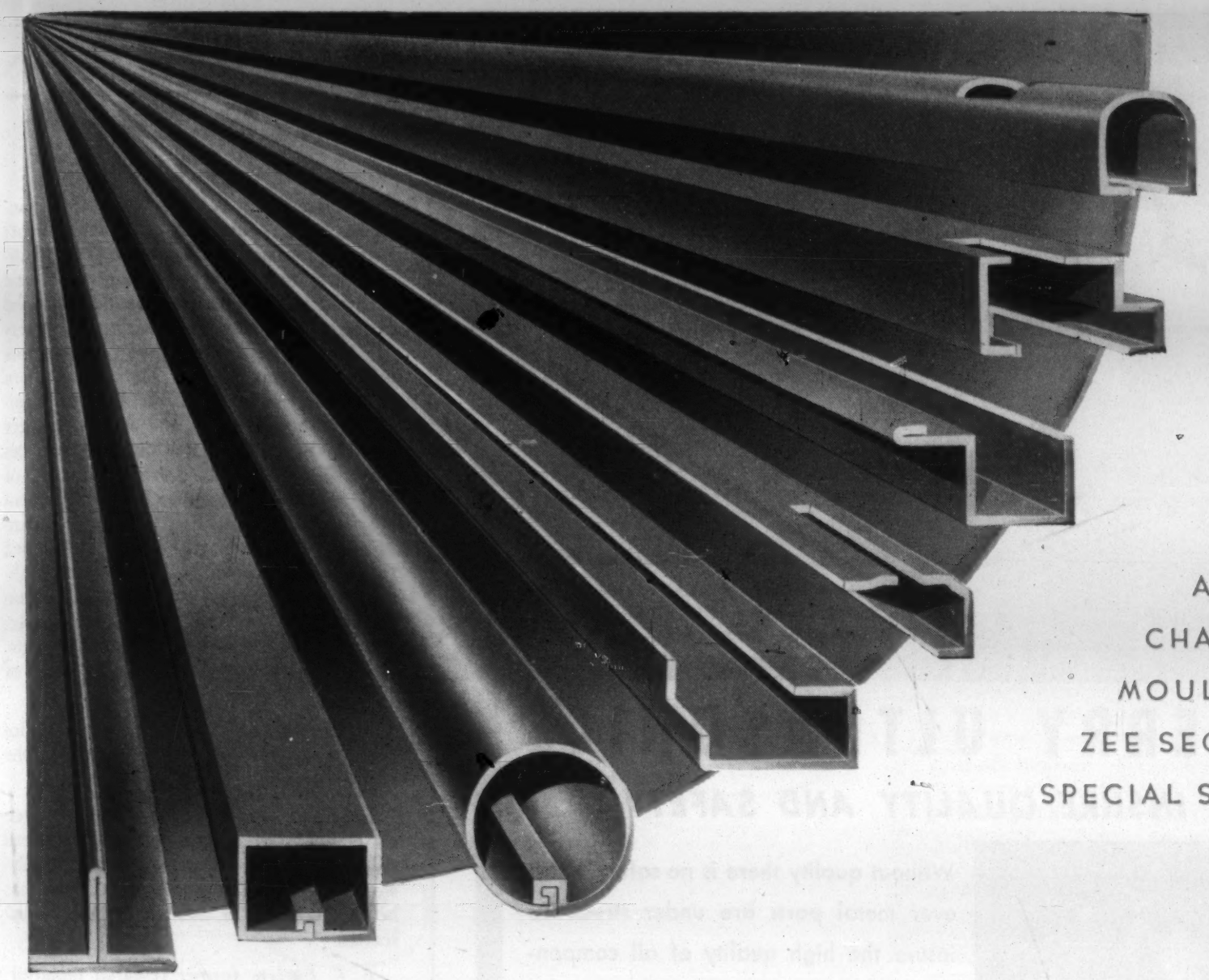
Major-General *Thomas F. Farrell*, assistant general manager of the U. S. Atomic Energy Commission since August 1951, has resigned to become managing director of ARO, Inc.

Transfer of *Frederick E. Darling* from the position of superintendent of assembly manufacture at Eastman Kodak Co.'s Camera Works to superintendent of manufacture at the company's Navy Ordnance Div. has been announced by the company.

Dennis E. Harvey has been elected a vice president of Magnesium Co. of America and will head the company's Washington, D. C. offices.

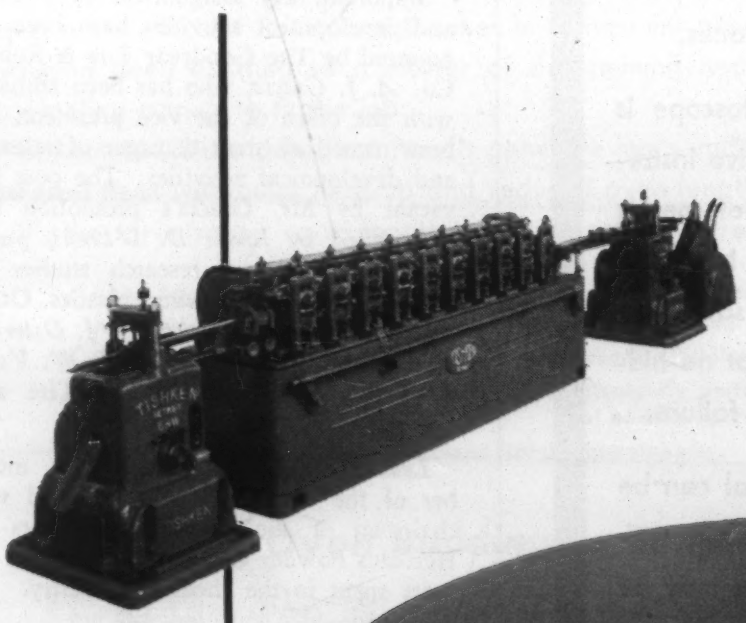
Hooker Electrochemical Co. has announced the following technical appointments: *Abram Davis* has been employed as a research chemist; *Beryl B. McKown* has been named technician in the physical laboratory; *Thomas Hooker* has been employed as a chemical engineer; and *William F. Harvey* has been made mechanical engineer

The following appointments and changes have been announced by General Electric Co. Four new section managers for the newly-created Silicone Products Dept., Chemical Div., have been announced. The men and their new positions are: *Robert O. Sauer,* manager-engineering; *James R. Donnalley,* manager-manufacturing; *Mark K. Howlett,* manager-marketing; and *Paul D. Williams,* manager-finance. *Elmer Devor* has been named supervisor of industrial engineering at the Coshocton, Ohio, plant. *John C. Helies* has been appointed general manager of the newly established Appliance Control Dept. Mr. Helies was formerly manager of manufacturing for the Vacuum Cleaner and Fan Dept., of the company's Small Appliance Div. Dr. *Ernest Ohsol* of the company's Chemical Div., has been named manager of the new product development laboratory. Four new appointments have been announced by the Meter and Instrument Dept.: *Donald E. Craig* has been named manager of the G-E Somersworth, N. H., plant; *John*



TEES
TUBES
ANGLES
CHANNELS
MOULDINGS
ZEE SECTIONS
SPECIAL SHAPES

faster production of finished roll formed parts



● Manufacturing of equipment may be your business . . . fabricating of parts is ours. We're experts in our line and can help you meet your commitments faster—cheaper.

Roll Formed Products Company's special equipment speedily turns out pieces by the thousands—by the millions, if needed. By our rolling operation instead of break-forming, we roll, punch, notch and size each piece in one fast operation—to precision detail.

Roll Formed Products Company makes its own dies to assure uncompromising specification accuracy. Consult ROLL FORMED PRODUCTS COMPANY when placing subcontract Defense Orders. Write for brochure of our facilities.

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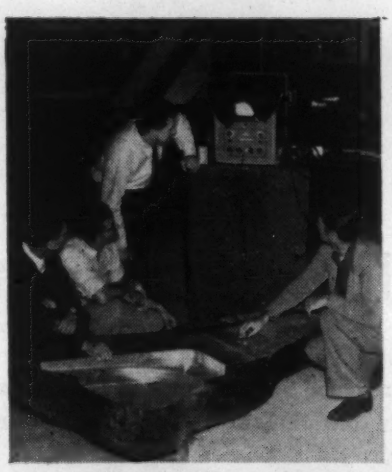
Sub-surface defects are quickly discovered with the Sperry Reflectoscope in the Grumman Aircraft Engineering Corp. plant.

SPERRY ULTRASONICS

INSURE QUALITY AND SAFETY



Large aluminum alloy forgings being tested after partial machining.

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Without quality there is no safety wherever metal parts are under stress. To insure the high quality of all components Grumman Aircraft Engineering Corporation uses Sperry Reflectoscopes to test raw materials and manufactured parts used in their famous planes.

The Sperry Ultrasonic Reflectoscope is the most modern non-destructive instrument for on-the-spot testing of metals for the detection of defects. Not only are many hours of machining saved but manufacturers are assured that no hidden flaws exist to cause later failure.

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REPRESENTATIVES IN PRINCIPAL CITIES

News Digest

C. Garrett has been appointed acting manager of marketing for the department; *Leo P. Hannaway* has been appointed assistant to the manager of marketing; and *Jeremiah E. McQuillan* has been named manager of marketing services. Managers of four newly established departments have also been named. They are: *Edwin E. Parker,* manager of the Design Engineering Services Dept. and acting manager of the Production Engineering Services Dept.; *Maynard M. Boring,* manager of the Technical Personnel Development Services Dept.; *Richard C. Sogge,* manager of the Standard Services Dept.; *Charles C. Leader,* manager of the Technical and Engineering Administration Services Dept. *William W. Trench,* secretary of the company for almost 24 years, has retired after a total of 37 years of service.

J. H. DuBois has been named vice president in charge of engineering for the Mycalex Corp.

Lloyd R. Cooper, director of research of Heppenstall Co., has been appointed chief metallurgist of the plant at Eddystone, Pa., and Dr. *Robert B. Corbett* has been appointed as acting director of research.

E. E. Ensign, former research metallurgist at Ford Motor Co., has joined the staff of the A. R. D. Corp. as vice president.

Important key assignments in research and development activities have been announced by The Goodyear Tire & Rubber Co. *A. J. Gracia,* who has been affiliated with the office of the vice president, has been named assistant manager of research and development activities. The post left vacant by Mr. Gracia's promotion has been filled by *James D. D'Ianni,* previously in charge of research studies on synthetic rubbers and vinyl plastics. Other assignments were those of *H. J. Osterhof* as director of research and *W. W. Vogt,* development manager of the Tire and Compounding Div.

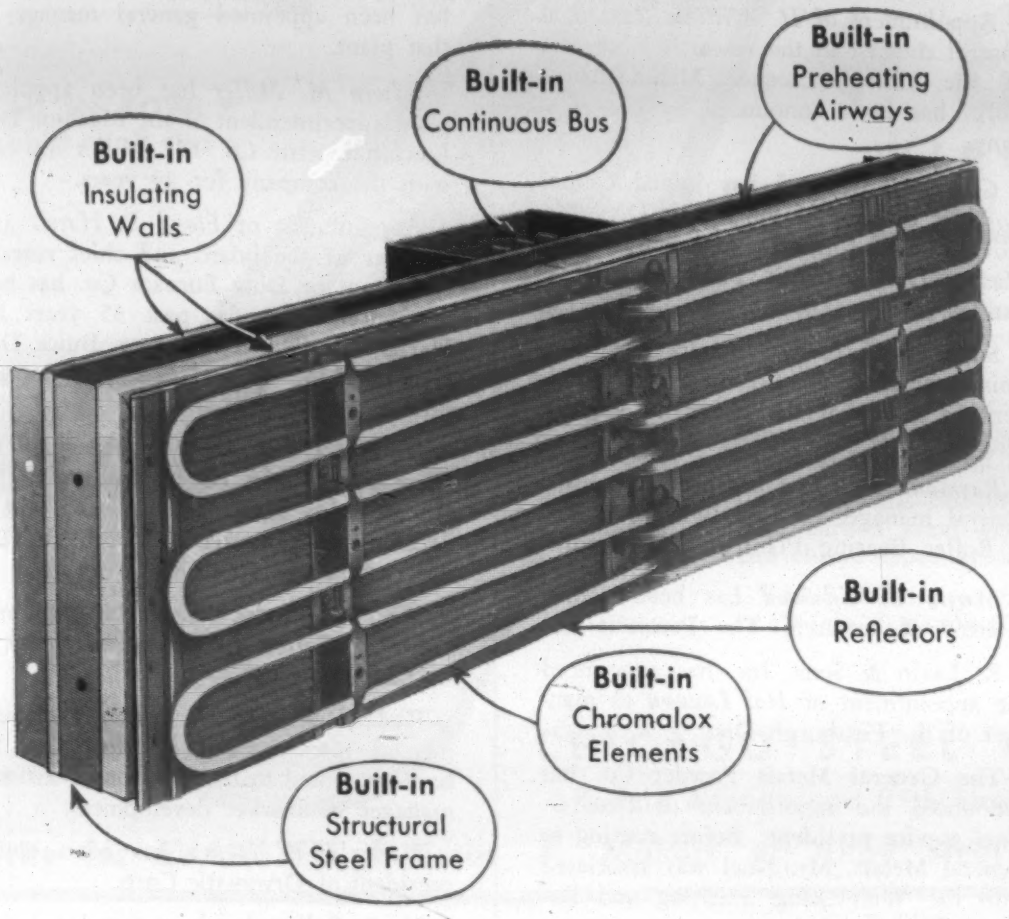
Leavitt N. Bent, vice president, member of the executive committee and vice chairman of the board of directors of Hercules Powder Co., has retired after 45 years spent in the chemical industry.

Nelson W. Dempsey has been appointed manager of operations of the Chicago district of American Steel & Wire operations. Mr. Dempsey succeeds to the position formerly held by the late *John R. Gaut.*

Chris H. Bartlett has been named manager of the Transformer Div. of the Westinghouse Electric Corp. Mr. Bartlett succeeds *Frank L. Snyder,* who last October was named manager of the company's Aviation Gas Turbine Div. *R. N. McCollom* has been appointed manager of the Application Engineering Dept. of the company's Transformer Div. to succeed

Announcing

a **new** and **better** *INFRARED* Generator



CHROMALOX *Electric* RADIANT PANELS

Now, more efficient *far*-infrared comes in convenient pre-engineered panels, reducing oven building to a matter of determining heat requirements and assembling panels to fit the job.

CHROMALOX Electric Radiant Panels generate more uniformly absorbed *far*-infrared heat with quick heat-up and reduced oven lengths.

It's the *far*-infrared wave length that makes the difference.

- ✓ **9200 Btu's per square foot output per hour.**
- ✓ **Insulated for voltages to 575 V.**
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- ✓ **Absolutely uniform radiation—no hot or cold spots.**
- ✓ **Built to UL and NBFU requirements.**

Now. . . Oven Building as Simple as

It's easy to build ovens of any desired height and length with lightweight Chromalox Electric Radiant Panels. Panels come in 1 x 4 ft. and 2 x 4 ft. sizes, ready to erect and connect with easy-to-follow instructions in each carton. Chromalox on-the-spot engineering assistance to help determine your requirements is yours—no obligation, of course.

CHROMALOX *Electric Heat*

Does More - Better - Consistently

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For Baking, Drying, Curing, Dehydrating

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2. **Shatter-proof construction**—nothing to break and contaminate.
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4. **Uniform heat**—no hot or cold spots.
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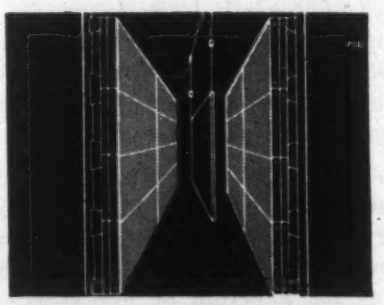
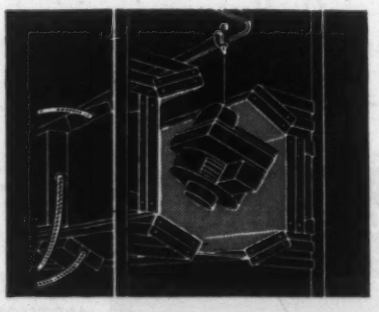


Easily erected banks of Chromalox Radiant Panels are ideal for line production. *Far*-infrared heat is radiated directly and uniformly without hot spots over entire work area.



Chromalox Radiant Panels can be erected into any oven shape. Rugged construction permits their use in assembly lines, even when hazards of splashed liquids, volatiles and moisture are present.

Get this Bulletin

It contains complete information, specifications and application ideas for the use of Chromalox Radiant Panels. Write for your copy today.

IC-66

News Digest

Mr. Bartlett.

Important promotions and appointments have been announced by the Illinois Institute of Technology. Dr. *Ralph G. Owens* has been named dean of engineering to replace Dr. *John T. Rettaliata,* who was recently named president; *Robert J. Mindak,* assistant research engineer for Standard Oil Co., has been appointed an associate engineer in the Heat-Power Dept. at Armour Research Foundation, while *Harry W. Wagner* has been appointed a research assistant in the same department. *Bruno Ulrick* has been appointed an assistant engineer in the Mechanism and Propulsion Dept. of the Foundation. Other appointments in the Heat-Power Dept. are those of *James E. Ash* as associate research director, and *Jack C. Hedge* as an assistant engineer. *John F. Schnur,* foundry superintendent for the McLean Iron Works, has been named foundry technologist at the Foundation. *Harvey B. Nudelman* has been named research assistant in the Foundation's Metals Dept.

Z. R. Williams has been appointed vice president and works manager for Portable Electric Tools, Inc.

Atlantic Research Corp. has announced the appointment of *Maurice F. Murphy* to its staff of chemical engineers.

Donald L. Taylor has been appointed manager of general developments in the Development and Research Dept., Hooker Electrochemical Co. Mr. Taylor has been with the company since 1936 as a chemical engineer and project leader.

Two Norton Co. executives were elected members of the National Industrial Conference Board, Inc. *Clifford S. Anderson,* Advisory Council, was elected a Member-Emeritus for a period of five years and *Wallace T. Montague,* vice president, was elected a member of the board, replacing Mr. Anderson.

Stanley D. Margerum has joined the R. M. Hollingshead Corp. as manager of special products for the Industrial-Aviation Div.

Two promotions have been announced by the Osborn Manufacturing Co. *Robert W. Ellms* has been promoted to assistant chief engineer while *Ted Hatch* has been named supervisor, Research and Development Dept., Machine Div. Both men were engineers in that division.

Appointment of *H. William Russell* as control chemist in the research laboratory of the United Lacquer Manufacturing Corp. has been announced by the company.

George P. Kovach has joined Clopay Corp. as director of the Plastic Div. Mr. Kovach was formerly manager of the Plastics Div., Atlantic Tubing and Rubber Co.

Sunbeam Corp. has announced the appointment of *L. W. Prestin* as vice president in charge of the Industrial Furnace Div.

Raymond S. Wood has been appointed general manager of Link-Belt Co.'s Ball & Roller Bearing Plant in Indianapolis.

Martin E. Gilwood has been named director of research, The Permutit Co.

R. Lavin & Sons, Inc. has announced the appointment of *Hal Lennon* as manager of the Pittsburgh Div.

The General Metals Powder Co. has announced the appointment of *Don O. Noel* as vice president. Before coming to General Metals, Mr. Noel was associated with the Wah-Chang Smelting and Refining Co.

The Polytechnic Research and Development Co. has announced the following promotions: *Herbert A. Finke* as director of engineering, and *Harmon R. Traver* as manager of manufacturing.

J. R. Weaver, vice president, Defense and Special Products Div., Baldwin-Lima-Hamilton Corp., has resigned to accept a position on the staff of the recently appointed vice president in charge of manufacturing at Westinghouse Electric Corp. Foundry, Defense and other Special Products, previously under Mr. Weaver's supervision, will be combined with the Southwark Shop into one group to be known as Southwark and Special Products Div., which will be under the direction of *R. B. Crean,* vice president. *Walter A. Rentschler* has been named vice president in charge of the Eddystone Div. Mr. Rentschler, who has previously been vice president in charge of the Lima-Hamilton Div., will continue in charge of the Hamilton plant, which will come under the immediate supervision of *J. F. Connaughton,* who has been appointed general manager of that plant.

Edwin M. Miller has been appointed plant superintendent of the Machine Div., Lincoln Electric Co. Mr. Miller has been with the company for 29 years.

Appointment of *Floyd E. Harris* as a member of the board and chief research consultant of Dow Furnace Co. has been announced. For the past 35 years Mr. Harris was furnace engineer, Buick Div., General Motors, and has just recently retired.

Harold C. Erskine, manager of the Cleveland Works of Aluminum Co. of America, has been named to the post of assistant division manager for ALCOA's die casting operations.

Michiana Products Corp. has appointed *Harry A. Porter, Jr.* to assume charge of its Chicago office.

Richard W. Dalzell, manager of commercial research, Lukens Steel Co., has been promoted to the position of assistant manager of market development.

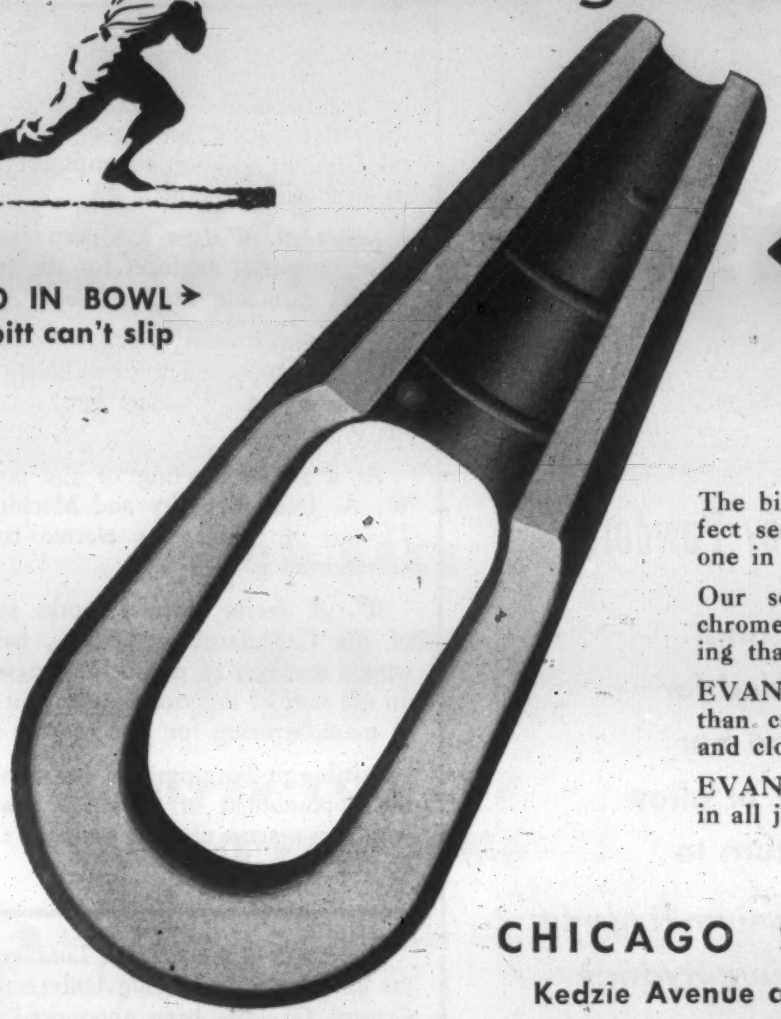
Winfield B. Heinz has been named president of Dryomatic Corp.

H. O. Fullam has been appointed chief industrial engineer in charge of methods engineering, tool engineering, tool manufacturing and maintenance of plant equipment at the C. H. Wheeler Manufacturing Co. *Robert J. MacMeekin* has been transferred from Hamilton, Ohio, as chief engineer of the Pump Div. of the company.

The Continental-Diamond Fibre Co. recently announced the appointment of *Harry K. Collins* as director of manufacturing. Mr. Collins was formerly the general manager of the Laminated and Insulating Products Dept. of General Electric Co.

H. C. Meyer, newly appointed chair-

...batting 1.000 for DURABILITY!



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WIRE ROPE SOCKETS
without ONE recorded service failure

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Our sockets are exceptionally long-lived because they're made of chrome-nickel-molybdenum steel, with a tensile strength after annealing that averages up to 60% greater than ordinary carbon steel.

EVANSTEEL Sockets are *alloy* steel, therefore stronger and lighter than carbon steel besides giving longer service. Available in open and closed types, from ¼" and up.

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Kedzie Avenue and 37th Street, Chicago 32, Illinois

Write for EVANSTEEL Bulletin • *Makers of Alloy Steel for Over 40 Years*

News Digest

man of the board for Foote Mineral Co., has announced the election of *Gordon H. Chambers* as president. Mr. Chambers was elected vice president and treasurer in 1936 and has been executive vice president since early in 1951.

Dr. *Harry G. Mitchell,* of the Speer Carbon Co., has received an award for outstanding accomplishment in the advancement of powder metallurgy and its greater application in industry, which was presented by the Metals Disintegrating Co. on the occasion of its 35th Anniversary.

C. O. Wanvig, Jr., formerly secretary of the Peerless Machine Co., was elected president of the company at a recent directors' meeting. Mr. Wanvig succeeds the late *J. R. McDonald.*

Dr. *Charles N. Kimball,* president of Midwest Research Institute, has been named a Fellow of the Institute of Radio Engineers.

The appointment of *Clifford R. Meyer* as vice president and secretary of The Morris Machine Tool Co. has been announced by the company.

The appointment of *John Nuber* as assistant chief engineer and *Stewart Miller* as supervisor of engineering standards and development has been announced by Detrex Corp.

Norman C. Penfold, supervisor of automotive and engine fuels and lubricants research, has been named an associate director of Southwest Research Institute.

Election of *Allen Latham, Jr.,* as a vice president of Arthur D. Little, Inc. has

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Gentlemen:

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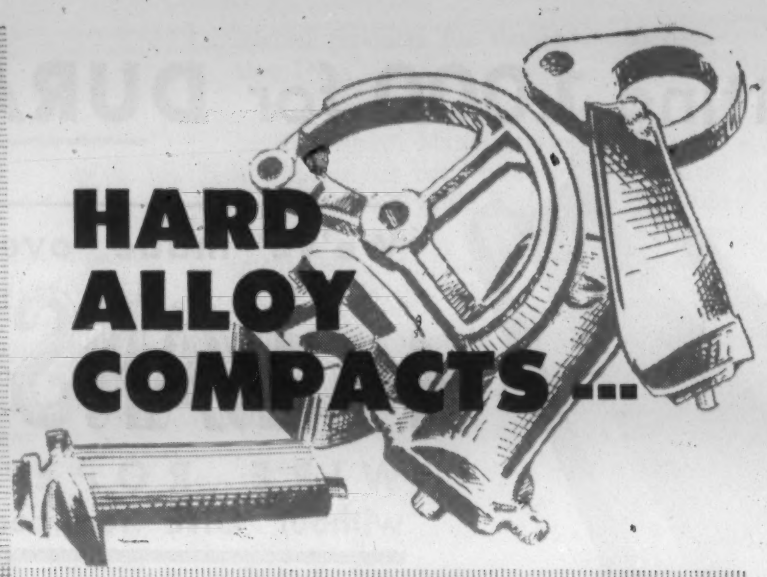

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. . . without the high cost and expensive equipment needed for sheet metal fabrication and bar stock for small metal and/or alloy parts, metallurgists now turn to

Titanium Metal Powder . . . Titanium Hydride
Zirconium Powder . . . Zirconium Hydride

Equal to the low cost advantage of pressing and sintering for small parts, (such as components requiring hardness, corrosion resistance, and high temperature service) are the considerations that *no waste* results when these powders or hydrides are employed. Particles are homogeneous alloys, thus insuring homogeneous products.

Available from Metal Hydrides Incorporated are powders of titanium and zirconium alloyed with Nickel; Chromium; Cobalt; Manganese; Thorium; Uranium; Tantalum; and Niobium (formerly Columbium)

Titanium hydride can be sintered under vacuum to produce Titanium metal.

Zirconium hydride can be likewise handled to produce Zirconium metal.

Save time, money, investment in equipment and machinery, and waste by using Metal Hydrides alloy powders.

MH METAL HYDRIDES INC

12-24 CONGRESS STREET • BEVERLY • MASS.

News Digest

been announced. Mr. Latham will continue as technical director of the Mechanical Div., in addition to responsibility for its over-all operation.

James M. Walton has been appointed plant industrial engineer for the Midland Works, Crucible Steel Co. of America.

The Refractories Div., Carborundum Co., has announced the promotion of *H. M. Killmar* to assistant works engineer for the division.

At a recent meeting of the board of W. A. Jones Foundry and Machine Co., *Thomas A. Jones* was elected company president.

W. A. Irvine, former works manager of the Canadian Electric Co., has been named manager of production engineering on the staff of the vice president in charge of manufacturing for The Maytag Co.

Pittsburgh Forgings Co. has announced the appointment of *Frank G. Tuerk* as works manager of the company's Coraopolis, Pa., plant.

The death of *George Lee Lindsay,* director of tests and research, Universal Atlas Cement Co., has been announced by the company.

Pyrene Manufacturing Co. has announced the death of its president, *Wallace Banta Phillips.*

American Society for Testing Materials has announced the death of *C. Laurence Warwick,* executive secretary and administrative head of the Society since 1919.

The death of Dr. *Lewis Warrington Chubb,* director emeritus of the Westinghouse Research Laboratories and nationally known leader in the field of science, has been announced by the company.

John G. Munson, former vice president —raw materials, United States Steel Corp. of Delaware, died at the age of 67 after a long illness.

News of Companies

Johnson Plastic Corp. has recently completed a 22,000-sq-ft expansion at its main plant on Brown Rd.

Zero Manufacturing Co. recently held open house for members of the electronic, aircraft and allied industries. The occasion marked the purchase of *Zierold Manfacturing Co.* by Zero, and the appointment of James M. Dobbie as vice presi-

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Oilite Products include:
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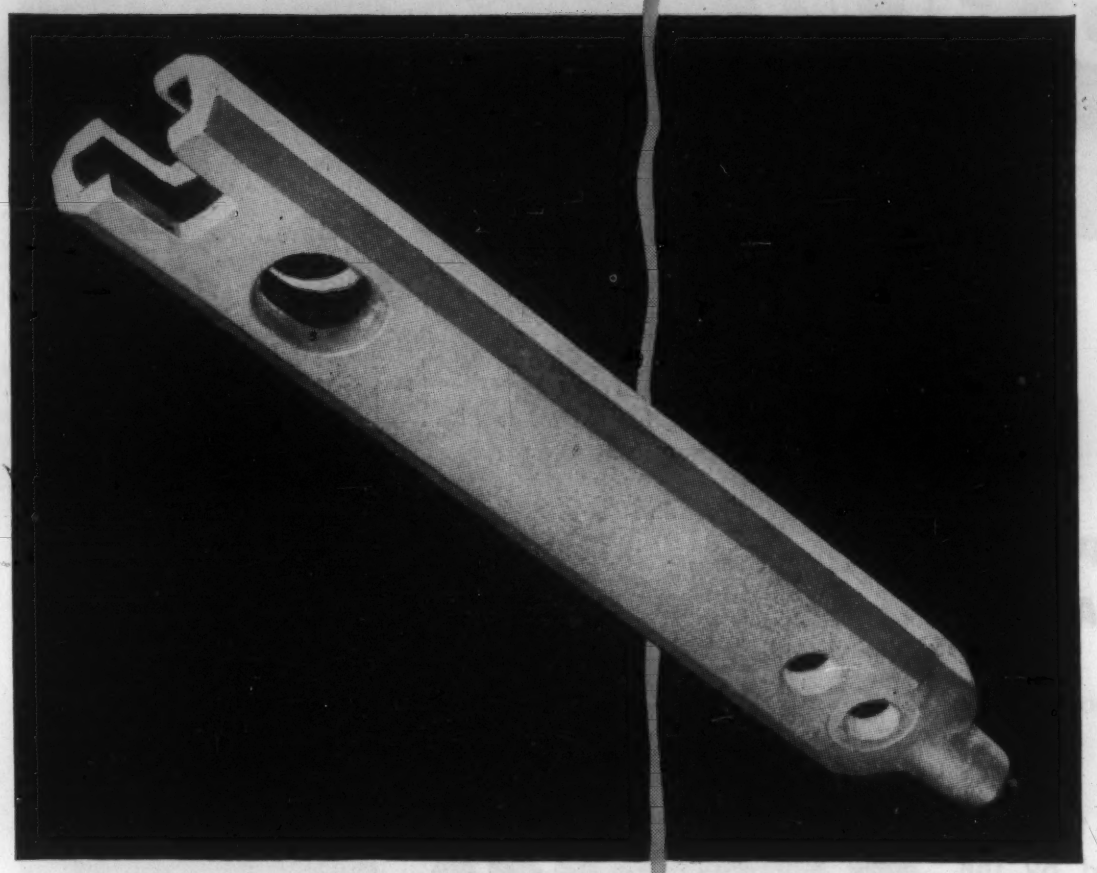

75¢ for this *Investment Casting*, compared to a former $2.17—same tool steel alloy, no machines or labor tied up producing it, and a more reliable product than before.

Previously machined as two halves from solid stock, it was then assembled by welding, milled and drilled. We *pour* the assembly as you see it here, ready for a few finishing touches.

Our use of expendable patterns gives the designer free rein, because we cast in almost any shape—many that can't be produced by any other process. We cast 160 ferrous and nonferrous alloys; a fraction of an ounce up to 5 pounds.

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when it looks impossible to cast

when machining costs are "out of sight"

when the alloy is a tough one

pour yourself an assembly with

PRECISION METALSMITHS INC.

INVESTMENT CASTINGS

News Digest

dent and plant manager.

Chain Belt Co. is now occupying its new administration building located at 4701 W. Greenfield Ave., Milwaukee.

This year marks the 50th Anniversary of *Standard Steel Corp.*, one of the West's oldest manufacturers. The company is planning a program of expansion which will include new buildings and increased manufacturing facilities to cost approximately $250,000.

Construction of a 90,000-sq-ft permanent magnet manufacturing plant costing, with equipment, over $3,500,000 has been undertaken by the *Carboloy Dept., General Electric Co.* The plant will represent a substantial increase over current facilities. The new plant is expected to be completed in the spring of 1953 and will be located adjacent to the Carboloy Dept.'s new standard carbide tool fabricating plant.

Allis-Chalmers Manufacturing Co. has announced plans for a $75,000 pilot plant for pelletizing and heat hardening taconite concentrates. The plant, being built at Carrollville, Wis., is expected to process 1 to 2 tons per hr of concentrated taconite fines.

In conjunction with the expansion program at *Metal Hydrides, Inc.*, ground was broken for the construction of a new research and chemical hydride building.

Directors of *Ferro Corp.* have authorized acquisition of a 50% interest in *The Wel-Met Co.*

The Lapointe Machine Tool Co. is currently celebrating its Golden Anniversary.

Ground has been broken for a new half-million dollar *Thomas A. Edison, Inc.*, laboratory at West Orange, N. J. The site is near the original brick structures built by Thomas A. Edison in 1887. The lab will work in the fields of storage and primary batteries, electrical instruments, dictating equipment, medical gases and hospital apparatus.

An addition of 37,000 sq ft to its present plant will be started by *D. J. Murray Manufacturing Co.* Completion is scheduled for September.

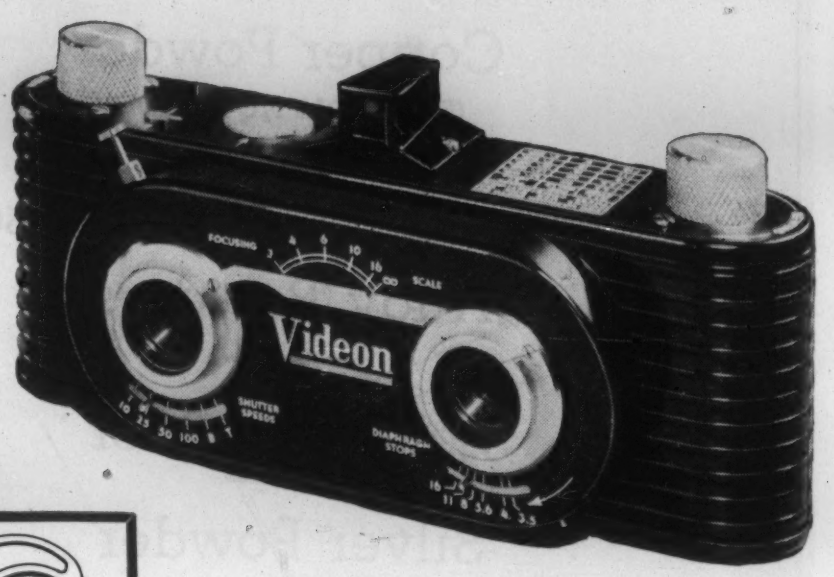
Cro-Plate Co. has announced expansion to include the entire area of 10,000 sq ft at the company's Hartford plant. The Contract Plating Div. of the organization, which formerly shared factory space with the manufacturing division, has been reduced and transferred to the East Hartford plant.

To meet the growing need for new sources of decorative plastics parts, a new organization specializing in the molding. painting and plating of thermoplastic parts has been formed by C. W. Krause The new organization is *Shawnee Plastics Inc.*, with the factory at 1801 W. Iowa St., Evansville, Ind.

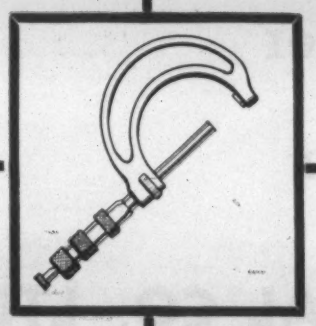
Texas Engineering and Manufacturing

When performance depends on dimensional STABILITY

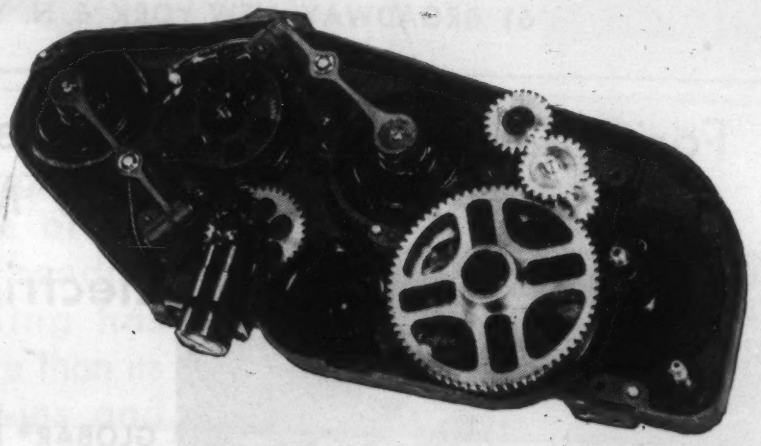
AIRCRAFT LANDING LIGHT PARTS
Grimes Manufacturing Co.



THREE-DIMENSIONAL CAMERA
Stereocrafters, Inc.



PORTABLE RECORD PLAYER
RCA Victor, Inc.



AERIAL CAMERA MAGAZINE
Ryan Industries, Inc.

...see how DUREZ phenolics measure up

● When products or parts must hold their size and shape, even under adverse service conditions, Durez phenolics are often the best answer. Best from the cost angle, too.

In the case of the aircraft landing light, plastic components of the lowering and raising mechanism function unfailingly in all sorts of weather.

The slick black body of the 3-dimensional camera conforms to the close tolerances that hobbyists expect, yet use of Durez cut many dollars from the selling price.

In the record player turntable, vertical wobble or lack of concentricity are successfully avoided. In the aerial camera magazine, the Durez and metal used were tested to function successfully together in a temperature range of −65° F. to +160° F.

Dimensional stability is but one in a long list of properties offered by the hundreds of phenolic materials we have developed. Resistance to heat, to impact, moisture, and chemicals, electrical strength, light weight, and lustrous natural surface are others. Most important these days, availability and finished cost make phenolics a wise choice.

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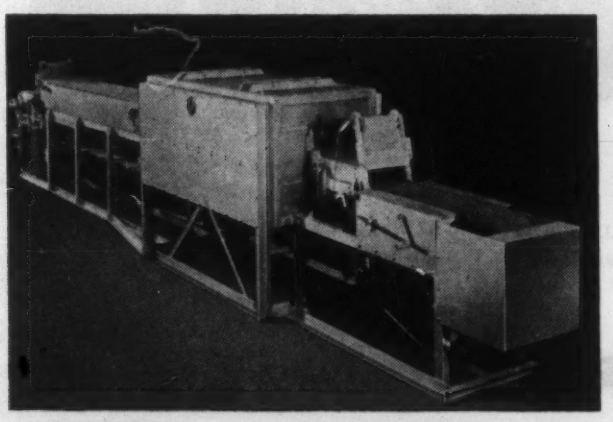

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because of high concentration of power produced by Globar heating elements resulting in more rapid heating of charge.

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due to continuous flow of product through a furnace chamber with accurately controlled atmosphere and temperature.

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because of labor saving continuous mesh belt operation of furnace resulting in greater production per furnace.

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* REG. T.M. CARBORUNDUM CO.

News Digest

Co., Inc., long known throughout the aircraft industry as TEMCO, has officially shortened its name to *Temco Aircraft Corp.*

The Meehanite Metal Corp. has entered into a contract to install the Meehanite casting manufacturing processes at the Franklin, Pa. foundry of the *Chicago Pneumatic Tool Co.*

The Barber-Colman Co. of Rockford, Ill. has purchased the principal assets of the *Wheelco Instruments Co.*

National Research Corp. has announced the opening of a modern 50,000-sq-ft, one story plant in Newton, Mass. In this new $600,000 plant, the Equipment Div. will engineer, design and fabricate its specialized process equipment for use in the chemical, metallurgical, electronic and coating industries.

The completion of a new research and engineering building has been announced by *Industrial Nucleonics Corp.* The firm's Radiochemistry Dept. will be housed in the new building, which is located across the street from the office and production buildings on Chesapeake Ave., Columbus.

The F. W. Wakefield Brass Co., Vermilion, Ohio, has established a research fund of $10,000 at the Massachusetts Institute of Technology and granted a student fellowship of $2650 to the Case Institute of Technology.

Charles Bruning Co., Inc. has announced operations in its new plant for sensitizing and converting paper, film and cloth at Teterboro, N. J.

The H. K. Ferguson Co. has been awarded a contract to engineer a process development plant for the Nickel Processing Co. The pilot plant will be built at the U. S. Government-owned Nicaro Nickel Plant in Nicaro, Cuba, which is operated by Nickel Processing Co. under a management contract.

The new $275,000 Wire Braided Hose Dept. at *Quaker Rubber Corp.*, division of *H. K. Porter Co., Inc.*, has been completed and is now in operation.

Three new buildings have been added to *General Electric Co.'s Transformer and Allied Products Div.* facilities at Pittsfield, Mass. The buildings, which cost more than 6 million dollars, have provided 94,520 sq ft more floor space. Operations in the buildings include manufacture of laminated cylinders for insulating transformer coils, production of copper conductors for transformers, and testing of high voltage bushings.

Pittsburgh Plate Glass Co. opened a new plant for the manufacture of industrial brushes at 3201 Frederick Ave., Baltimore.

Development and testing of combustion and control systems and instruments will be a major function of the new research and development laboratory now nearing completion at *Hagan Corp.'s*, Orrville,

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FIFTH
WHEEL
COMPANY
This leg-in angle ring presents one of the most difficult bending problems. King has produced more than its share of leg-ins and years of experience make it possible to produce these rings within normal tolerances.
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Do Your OWN Hard Chrome* Plating with the CRO-PLATER 100

Thermo-Controlled Heated Bath **Bench or Floor-mounted**
Plate and Strip in the Same Tank **Tank Size 12" x 15" x 12"**
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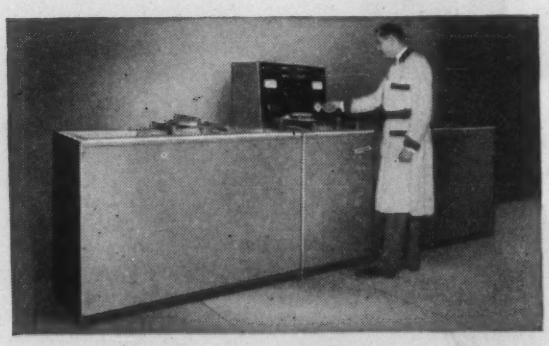
** Plate other metals, too!*

Look at the work you can do with the CRO-PLATER 100:

Flash chrome cutting tools for increased work life... plate in production quantities..."build up" mis-machined or undersized parts... plate to tolerances of .0001"... plate parts for wear, corrosion, erosion resistance ..."throw" chrome effectively on complex I. D. work... no limitations on type of work except size.

FREE FIXTURE DESIGN At no charge, fixtures will be designed for your specific needs. Arrangements can be made with the company to fabricate specialized fixtures.

CRO-SOL, a high speed plating solution Engineered for your individual plating requirements and for use only the CRO-PLATER units is CRO-SOL, a Cro-Plate Company development. This stable solution requires only the addition of water for immediate use and can be maintained indefinitely through periodic analysis.



CRO-PLATER 100 with auxiliary tanks

Auxiliary tanks for hot rinsing and alkali cleaning, cold rinsing and stripping are available in either stainless steel or black iron. Also available are other CRO-PLATERs ranging in size from 50 to 500 amps.

The Cro-Plate Company also maintains a complete Engineering Service Division to help solve your electro-plating problems. For further information . . . for price and delivery quotations . . . for sample work arrangements . . . write

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News Digest

Ohio, plant. The new laboratory will be known as the *J. M. Hopwood Research Building.*

An agreement for the formation of a company to manufacture plastics materials in Japan has been announced by *Dow Chemical International Ltd.* The new corporation, to be known as *Asahi-Dow Ltd.*, will be an associated company of Dow International and *The Asahi Chemical Industry Co., Ltd.* of Osaka and Tokyo.

Climaxing two years of coordinated production and testing of ceramic coated parts for high-temperature aircraft applications, *Ryan Aeronautical Co.* and *California Metal Enameling Co.* have announced they have combined their activities in this field.

The 150th anniversary of the establishment of *E. I. du Pont de Nemours & Co. Inc.*, will be marked July 18 at the site of the first company powder mills on the banks of Brandywine Creek. The ceremonies, which will include a simple historical dramatic prologue, addresses by company officials, and the dedication of a marker on the site of the first plant, are the focal point of observances by the du Pont Company.

The offices of *Hydropress, Inc.* and its *Rolling Mill Div.* will be moved to the Empire State Building, 350 Fifth Ave., New York 1, in June.

American Cyanamid Co. has announced the formation of a new corporation *Chemical Construction (Inter-American) Ltd.* A subsidiary, with main offices in Toronto, the new corporation will design and build chemical plants in all nations of the Western hemisphere except the U. S.

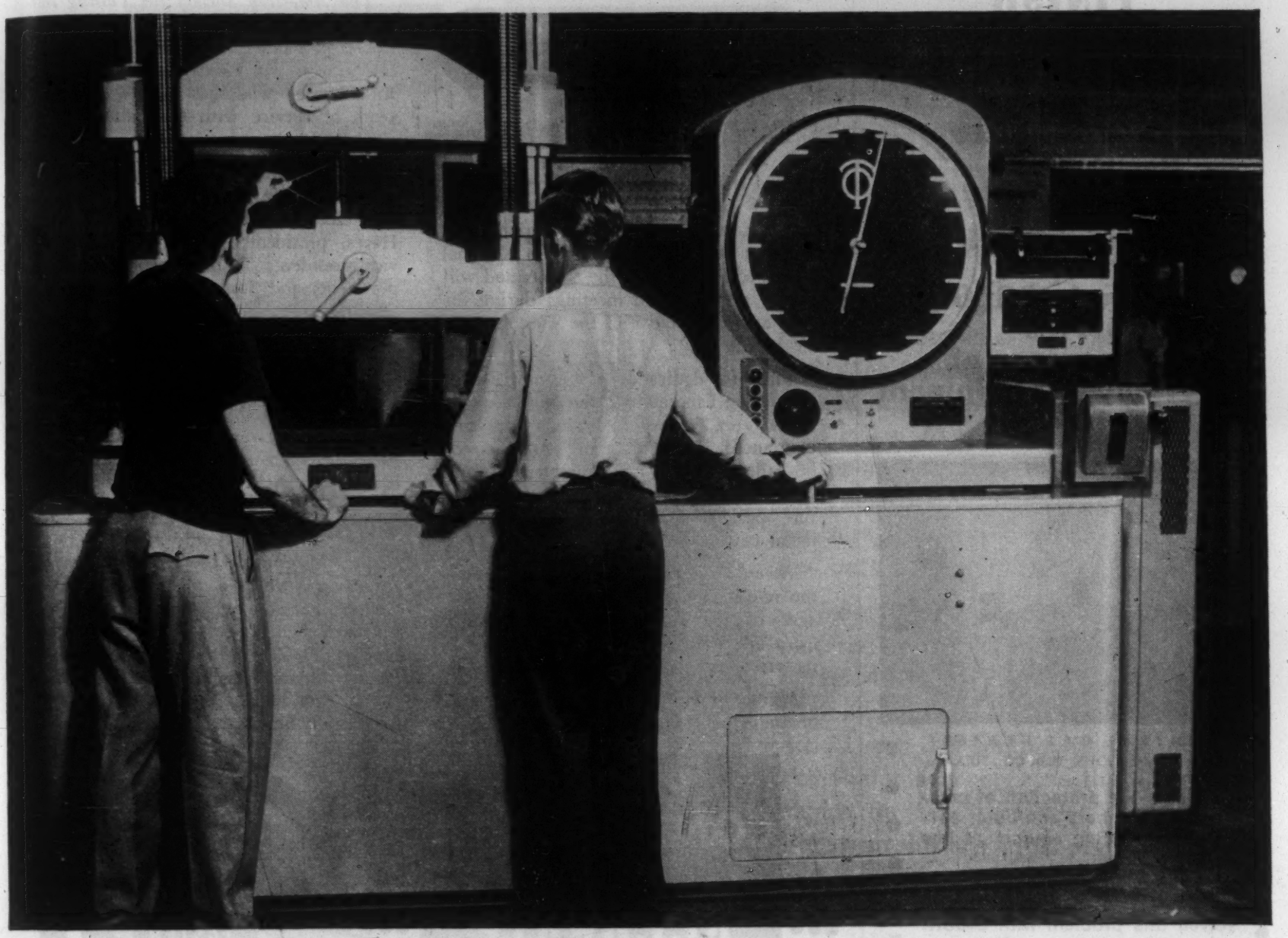
Ace Heat Treating Co. has announced expansion of its facilities to include vapor blasting and liquid honing, sand blasting and barrel finishing for tumbling, deburring and microfinish polishing.

United States Plywood Corp. has announced the opening of a new central laboratory in New York City. According to the company, the laboratory marks the beginning of an expansion program to increase research and development facilities in the field of low pressure plastics.

Housewarming ceremonies were recently held for the opening of *American Brass Co.'s* new Chicago warehouse at 4501 W. North Ave.

Dr. Paul Schwarzkopf, president of the *American Electro Metal Corp.*, Yonkers, N. Y., and owner of the *Metallwerk Plansee*, Reutte, Tyrol, has invited colleagues and friends of powder metallurgy to attend the First Plansee "De re metallica", which will take place on June 22-26, 1952, in Reutte. The tentative program includes lectures by the following American scientists: Professors G. J. Comstock and V. D. Frechette, and Drs. H. H. Hausner, W. J. Kroll, J. T. Norton and J. Wulff.

Olsen 200,000 lb. Electro-matic U.T.M. installed at Wayne University



The testing laboratory in the new Engineering Building at Wayne University in Detroit, Michigan, under the direction of Professor M. J. Lebow, is equipped with this 200,000 lb. Electro-matic Universal.

The four rotating screw design eliminated the expense of a pit. The null weighing system allows range changes at will during test; load is applied by thymatrol drive. Large easy-to-read multi-mask range selector dial, Olsen Electronic High Magnification recorder, and convenient push-button controls, are all incorporated in this rugged accurate machine.

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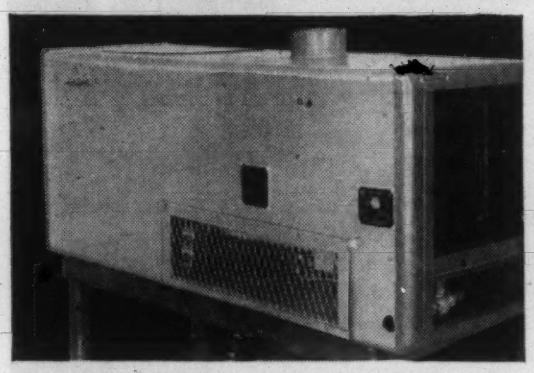

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For years the protection of combustion chambers and outer coverings of heating equipment has been a problem.

The John Zink Company, a leading manufacturer of gas heaters, solved this problem with SICON.

SICON protects their combustion chambers against extreme high heats of 875° without powdering or losing its color.

SICON, in attractive colors, also preserves the outside appearance of their products, adding greatly to sales appeal, and prolonging life.

The John Zink Company now uses SICON for all hot applications.

Inside and outside—SICON is the finish that can often do the job where all others fail.

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News Digest

News of Societies

Lee T. Bordner, president, Sierra Electric and Manufacturing Co., has been elected chairman of the Pacific Coast Section of the *Society of the Plastics Industry, Inc.* at the annual convention. Mr. Bordner was also elected to the National Board of Directors of the Society and will attend several board meetings during the year as representative of the Western Plastic Industry.

Plans for dedication of the new Metals Processing Laboratory at the *Massachusetts Institute of Technology* in June have been announced. The dedication program will be followed by a two-day technical conference on metal cutting, which will feature speakers of national reputation in the metal cutting field.

American Zinc Institute has announced the re-election of Russel B. Caples, manager of the Anaconda Copper Mining Co.'s operations at Great Falls Mont., as its president.

A grant of $1,000,000 to the new School of Industrial Management of the *Massachusetts Institute of Technology*, to be used exclusively for research and exploration in the fields of industrial management, has been announced by the Alfred P. Sloan Foundation. The new gift brings the total contribution of the foundation to the new school to $6,250,000.

The American Society for Testing Materials has announced the appointment of Robert J. Painter as the new treasurer of the Society. Mr. Painter succeeds John K. Rittenhouse, who has retired after 43 years of service with the national technical group.

At their 17th annual meeting, the *American Hot Dip Galvanizers Association, Inc.*, elected the following officers: D. M. Hayes, president; Frank W. Miller, 1st vice president; T. R. Gregory, 2nd vice president; and Stuart J. Swensson, secretary-treasurer.

The 20th annual meeting of the *Electric Metal Makers Guild, Inc.* was held on June 5, 6, 7 at French Lick Springs Hotel, French Lick, Ind. The speaker for the joint technical session was H. P. Rassbach, development engineer for the Electro Metallurgical Co., whose subject was "Gases in Steel".

The 8th biennial Pennsylvania Interchapter Meeting of the *American Society for Metals*, which is to be held in State College, Pa. on June 20 and 21, will feature addresses by many outstanding metallurgists. Dr. Zay Jeffries, retired vice president, General Electric Co., will deliver the keynote address on "Metals and Metallurgy of the Future".

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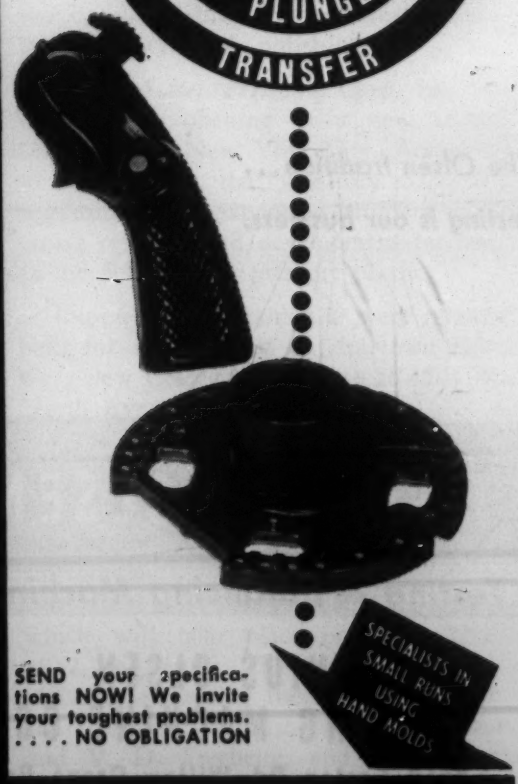
MOLD IT BETTER FASTER
PLUNGER
TRANSFER



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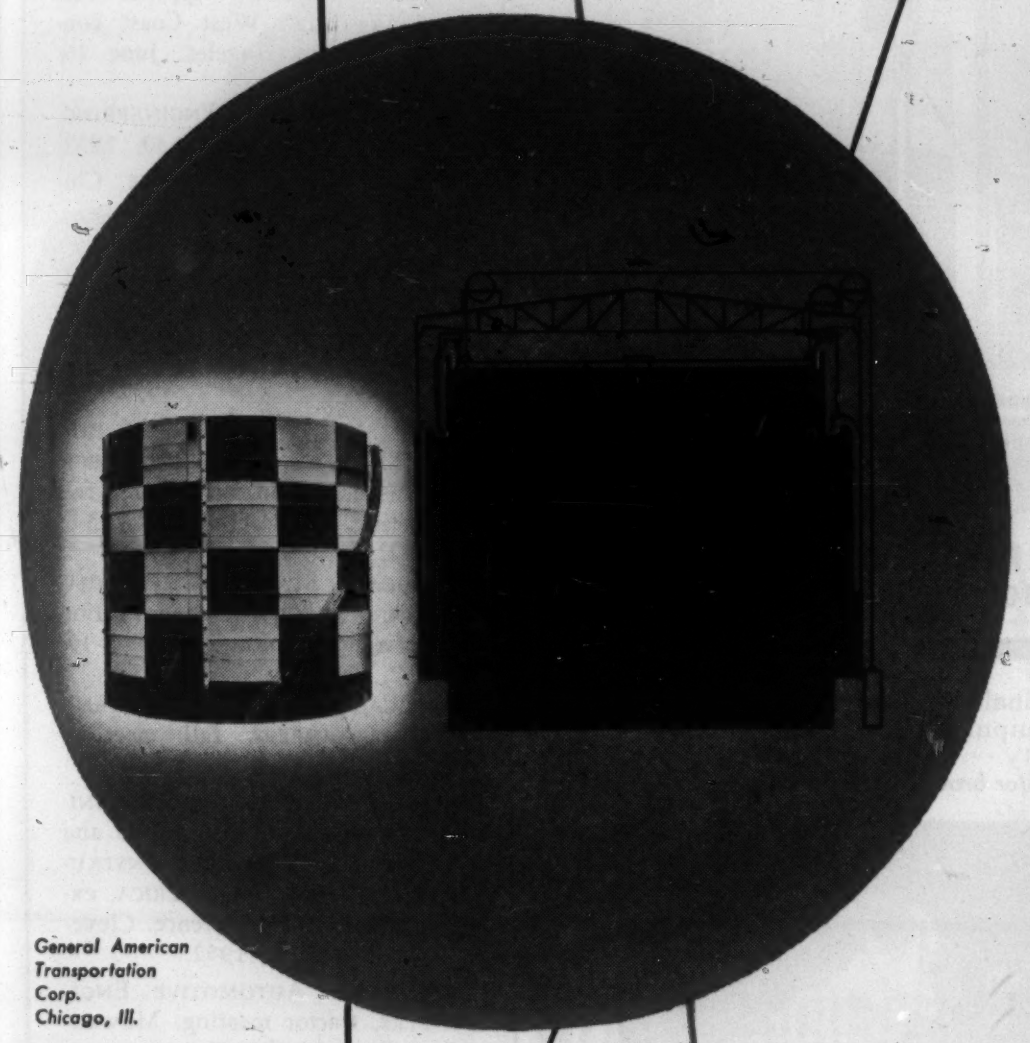
These properties of neoprene make a better GASHOLDER

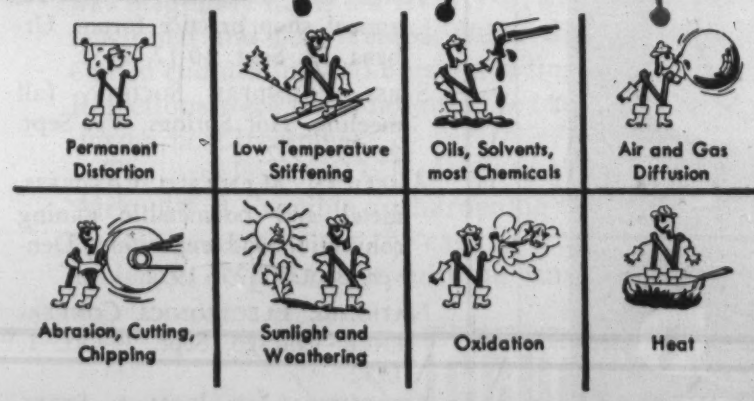


General American Transportation Corp. Chicago, Ill.

A fabric cover of woven asbestos, impregnated and coated on both sides with neoprene, acts as a "dry seal" in this gasholder for the storage of petroleum vapors, and chemical process and industrial gases. As gas is fed into the gasholder and the frictionless floating piston rises, the flexible seal, being under pressure, rolls off the telescoping fenders and onto the outer shell.

Neoprene was selected as the coating material because of its low permeability . . . resistance to chemical attack . . . and flexibility retained throughout its long life. It was this combination of properties that made neoprene the designer's choice for this particular application. For new solutions to old problems, more and more designers are turning to *neoprene* wherever a long-lasting resilient material is required.

PROPERLY COMPOUNDED NEOPRENE WILL RESIST:



Send for the "Neoprene Notebook." Each issue shows new, unusual applications of neoprene . . . new products . . . improved designs. Use the handy Reader Service card or write us directly. We'll add your name to our mailing list . . . and send information on other uses for neoprene and sources of supply, if you desire. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division A-6, Wilmington 98, Delaware.

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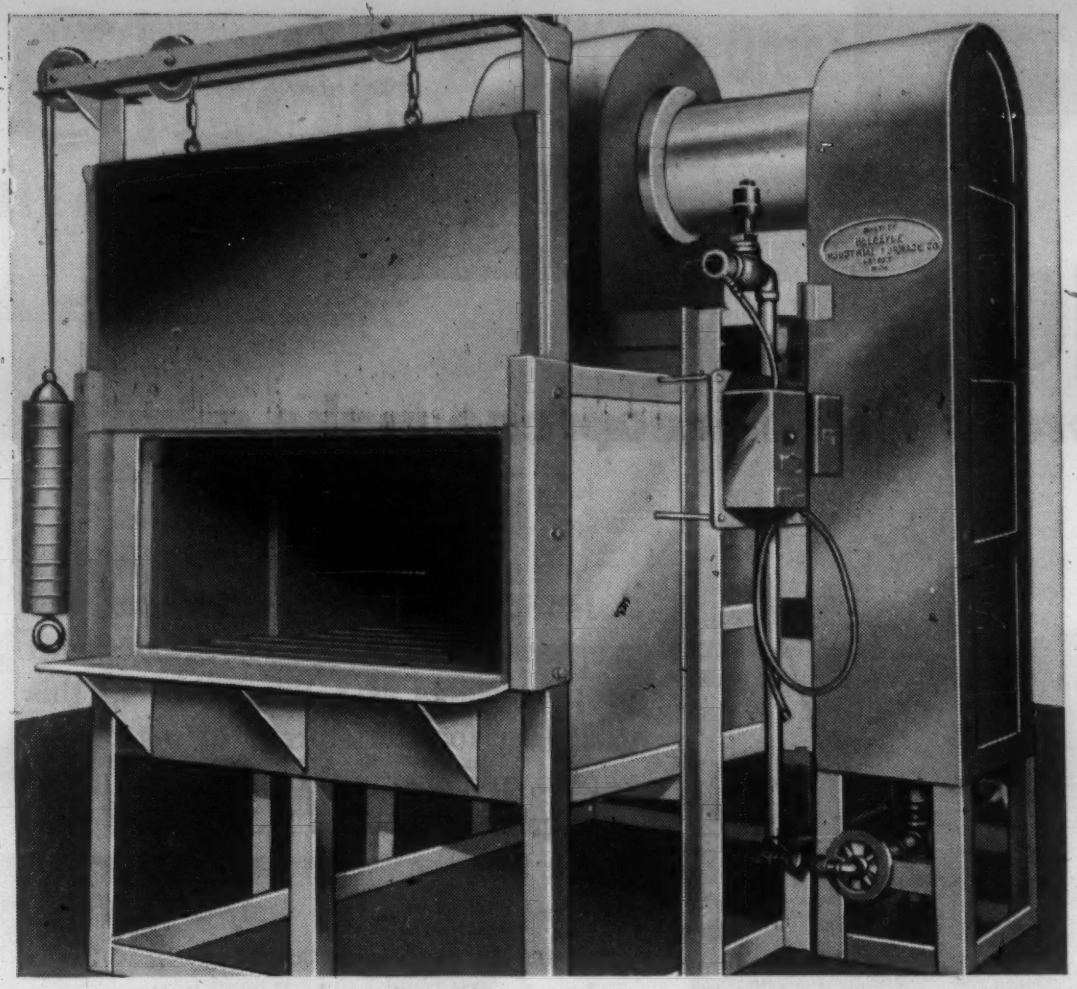

Batch type furnace for the heat treating of aluminum alloys—consists of atmosphere type burner mounted on the lower end of the duct which is used for re-circulating the air back into the furnace. Garden City high temperature fan is standard equipment for recirculating the heated air. This method of heating holds temperature with little or no variation. Mounting the burner in the duct, eliminates the necessity of an extra heating unit. . . . Send us your heat treating problems . . . our engineers will make a proposal without obligation.

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FILLING A GOVERNMENT ORDER. Final shipping inspection of air inlet horns used in jet test cell equipment. An example of the all-gage — all-metal — any quantity — spinning capacity available at Teiner. *Write for newest color brochure* 51

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Meetings and Expositions

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Applied Mechanics Div. conference. State College, Pa. June 19-21, 1952.

ALLOY CASTING INSTITUTE, annual meeting. Hot Springs, Va. June 22-24, 1952.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer general meeting. Minneapolis. June 23-27, 1952.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting. New York. June 23-27, 1952.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Applied Mechanics Div., West Coast conference. Los Angeles. June 26-28, 1952.

CENTENNIAL OF ENGINEERING. Chicago. July 1-Sept. 30, 1952.

INTERNATIONAL TRADE FAIR. Chicago. Aug. 2-17, 1952.

SOCIETY OF AUTOMOTIVE ENGINEERS, West Coast meeting. San Francisco. Aug. 11-13, 1952.

OAK RIDGE SUMMER SYMPOSIUM. Oak Ridge, Tenn. Aug. 25-29, 1952.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Industrial Minerals Div. fall meeting. Chicago. Sept. 3-6, 1952.

AMERICAN STANDARDS ASSOCIATION, national standardization conference. Chicago. Sept. 8-10, 1952.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, fall meeting. Chicago. Sept. 8-11, 1952.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Instruments and Regulators Div. and INSTRUMENT SOCIETY OF AMERICA, exhibit and joint conference. Cleveland. Sept. 8-12, 1952.

SOCIETY OF AUTOMOTIVE ENGINEERS, tractor meeting. Milwaukee. Sept. 9-11, 1952.

AMERICAN CHEMICAL SOCIETY, national chemical exposition. Chicago. Sept. 9-13, 1952.

PORCELAIN ENAMEL INSTITUTE, annual shop practice forum. Urbana, Ill. Sept. 10-12, 1952.

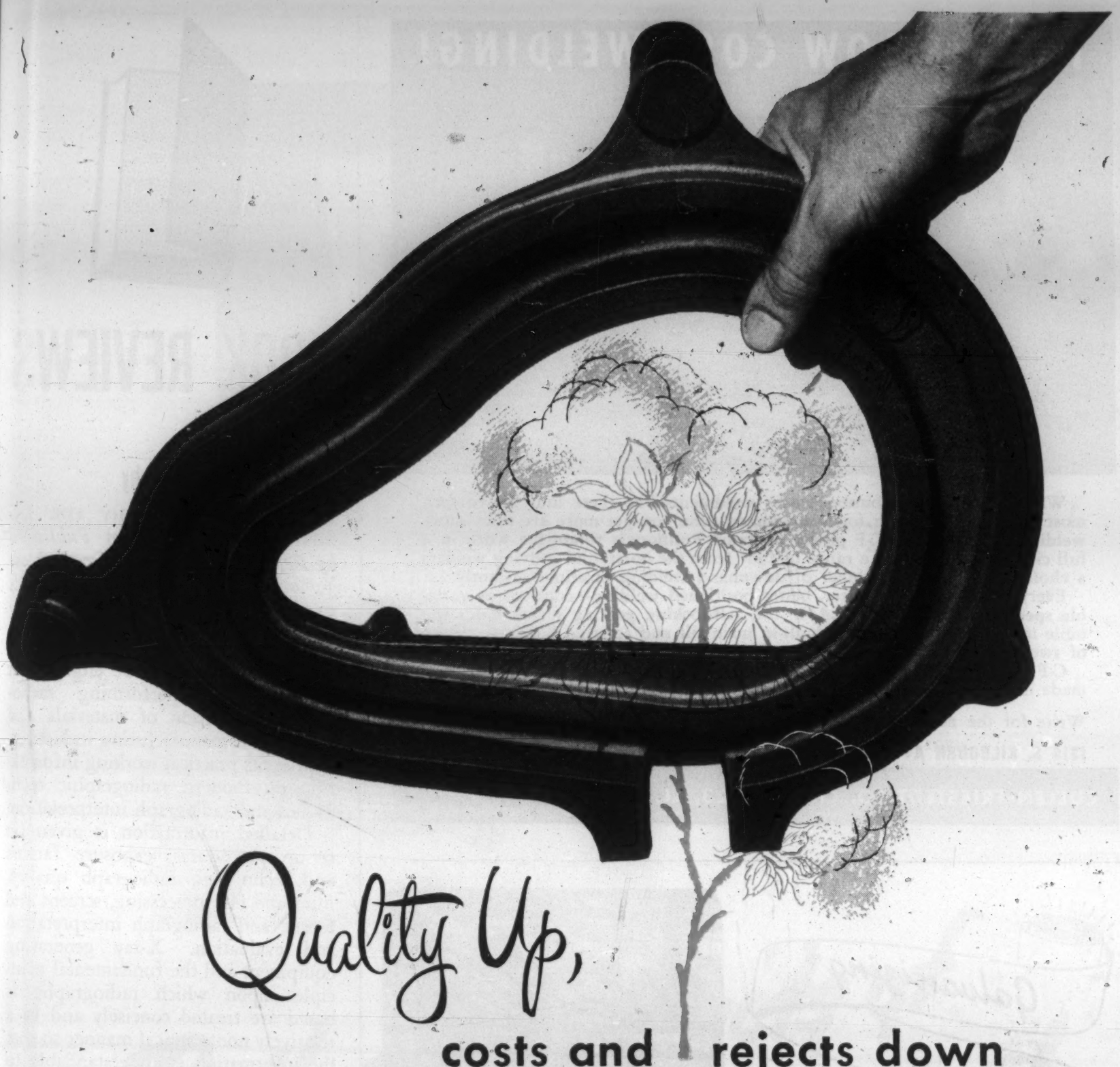
STEEL FOUNDERS' SOCIETY, fall meeting. Hot Springs, Va. Sept. 22-23, 1952.

AMERICAN MINING CONGRESS, metal and nonmetallic mining convention and exposition. Denver. Sept. 22-25, 1952.

NATIONAL ELECTRONICS CONFERENCE. Chicago, Sept. 29-Oct. 1, 1952.

ASSOCIATION OF IRON & STEEL ENGINEERS, annual convention. Cleveland. Sept. 30-Oct. 3, 1952.

GRAY IRON FOUNDERS' SOCIETY, annual meeting. Cleveland. Oct. 16-17, 1952.



Quality Up, costs and rejects down WITH CRUCIBLE TOOL STEEL CASTINGS

The steel part shown above used to be a production headache. A cam for a cotton picking machine, it was originally flame cut from SAE 8730 boiler plate, machined and heat treated. Other difficult steps included end-milling and finish-grinding the cam track. Rejections were high, because the cam often warped during heat treatment.

The problem was solved by casting the cam in Airkool®, a Crucible air-hardening tool steel. When the customer receives the casting from Crucible, all he has to do is finish it, mill the cam track and heat treat. He doesn't have to finish grind — Airkool is non-deforming when properly hardened and tempered. Machining costs are way down and quality is up, since Airkool resists wear far better than the low alloy steel from which the part used to be made.

Crucible's casting facilities often make it possible to use wear- and abrasion-resisting tool steel for complicated machine parts. We may be able to help you just as we helped the cotton picking machine manufacturer. Get in touch with Crucible today!

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52 years of Fine steelmaking

first name in special purpose steels

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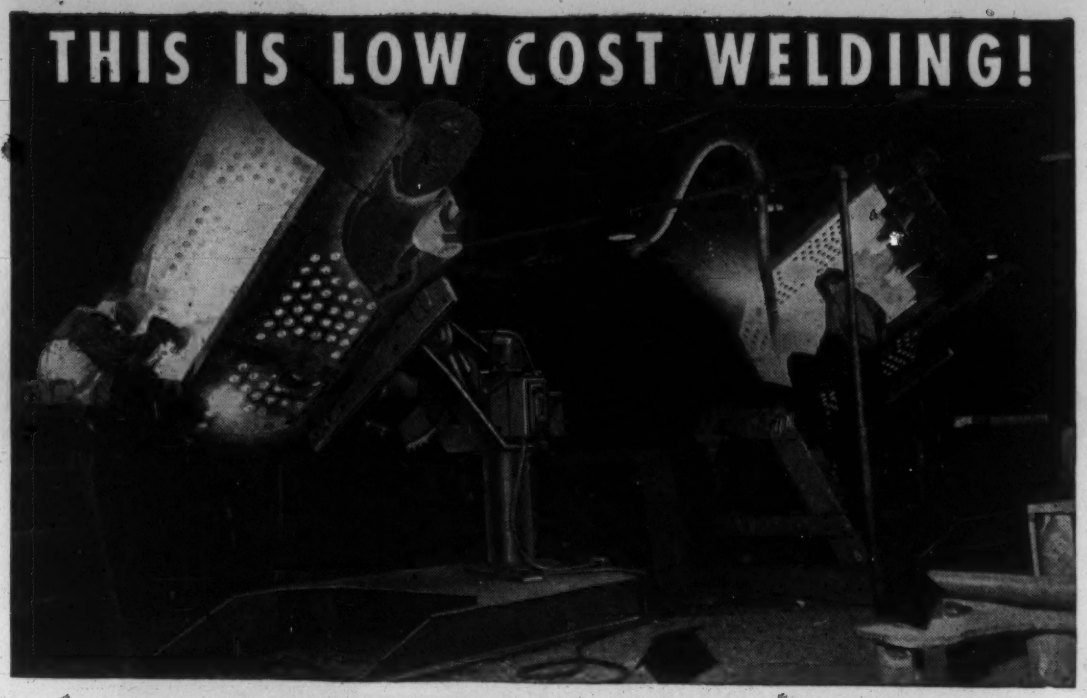
CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS



When a touch on a button moves weldments like these into the correct, most convenient position for a downhand pass, you get more arc time, more welding at lower cost. C-F power operated Positioners rotate the work in a full circle at any point in a range of 135° from the horizontal—giving welders a choice of an infinite number of downhand welding positions instantly.

Every requirement for faster, better positioned welding—constant or variable speed table rotation, full 135° tilt, self-locking gearing which holds the table in any position, oversize built-in main tilt and rotating bearings, choice of two base styles, and many other features—are built into C-F Positioners.

C-F Positioners are available in Hand or Power operated models, and are made in capacities up to 30,000 lbs. and larger.

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Strip in single or multiple strands up to a total width of 54" may be bright annealed or normalized, continuously, in this EF gas fired radiant tube installation. Capacity 7200 lbs. per hour.

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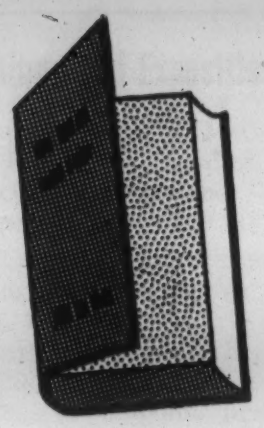


BOOK REVIEWS

Industrial Radiography

PRACTICAL RADIOGRAPHY FOR INDUSTRY. *By H. R. Clauser. Published by Reinhold Publishing Corp., New York 36, N. Y., 1952. Cloth, 6¼ by 9¼ in., 301 pages. Price $7.50.*

This book is written for those who are now or who will be engaged in planning and performing radiographic inspection of materials and parts in the manufacturing industries. It presents practical working information on modern radiographic techniques and radiograph interpretation.

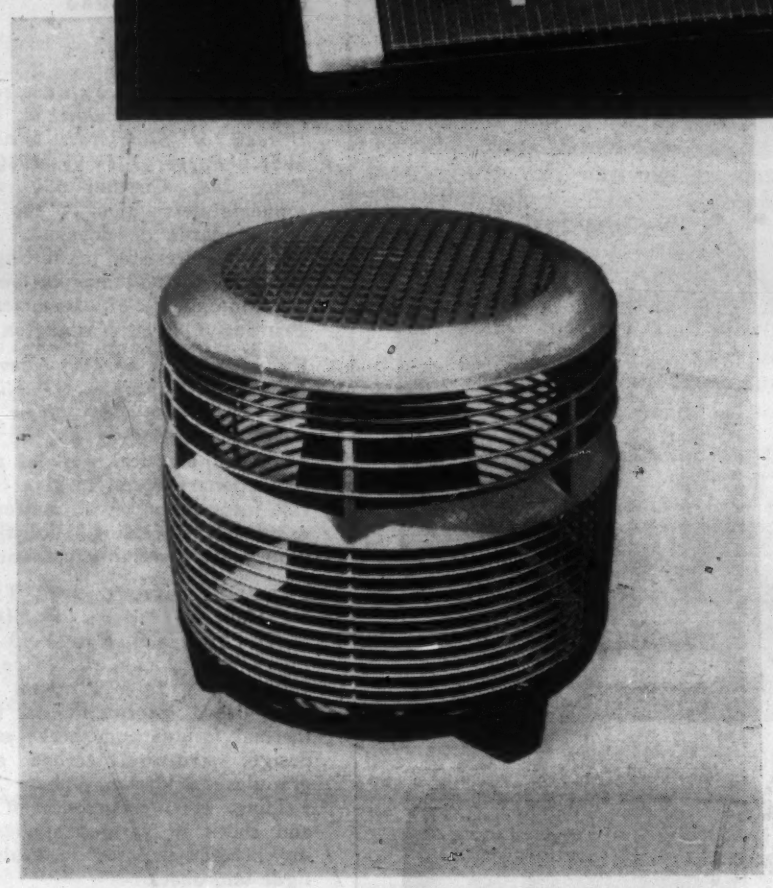
Detailed information is given on set-up procedures, exposure factors and techniques, radiograph quality, films and film processing, screens and filters, and radiograph interpretation and evaluation. X-ray generating equipment and the fundamental principles upon which radiography is based are treated concisely and in a relatively nontechnical manner so that the information is understandable to those with little or no training in physics or mathematics.

Among the most important chapters in the book are those covering in detail the radiographic inspection of arc welds, spot welds, and ferrous and nonferrous castings. Included in these chapters are excellent reproductions of radiographs showing actual defects, and also cross section photographs showing how and where the defects are located inside the metal. In addition, the applicable standards are described and explained.

Separate chapters are also devoted to radiography using radium and cobalt 60, fluoroscopy, high-voltage radiography, and miscellaneous applications, including microradiography and thickness gaging.

Because of its practical approach, this volume should appeal to radiographers, inspectors, metallurgists, en-

(Continued on page 234)



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Modern Air Conditioner. Strength, wearability and complete utility are prominent features of this important fixture.

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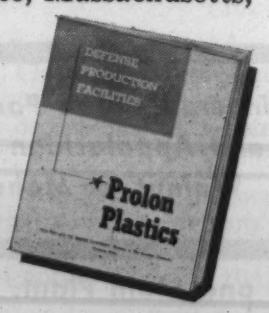
Prolon has plants at Florence, Massachusetts, and Toronto, Canada. Prolon services cover the field—from research and design to molding (compression and injection) and assembly. Send for this free booklet, showing the complete range of Prolon facilities. Address:



Prolon Plastics (D) Pro-phy-lac-tic Brush Company, *Florence, Mass.*

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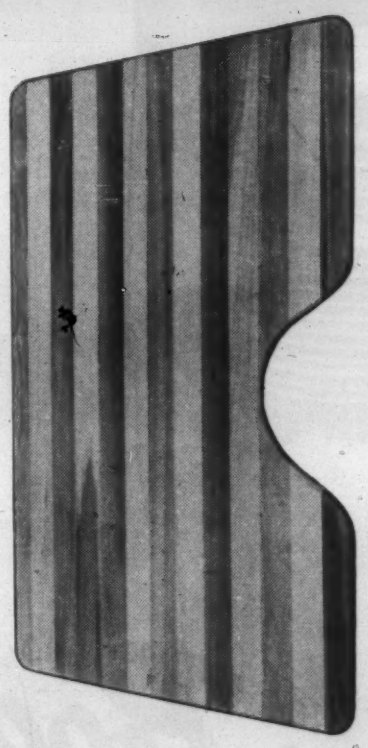
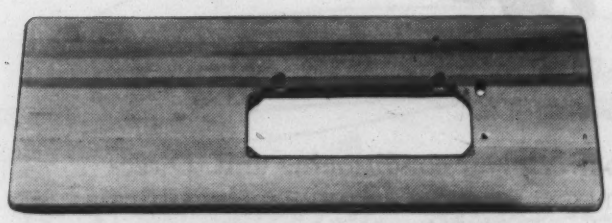
Wood is the preferred material for work surfaces in many industrial applications. The table of this sewing machine is just one of numerous instances in which Gamble Brothers' knowledge of wood-engineering and their unusual wood-fabricating facilities are called upon by industrial designers and manufacturers.





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Book Reviews

(continued)

gineers, and technicians who are concerned with nondestructive testing.

Other New Books

AN ADHESIVE TAPE-RESISTOR SYSTEM. *By B. L. Davis. Published by the National Bureau of Standards, Washington, D. C., 1952. Paper, 7⅛ by 10⅛ in., 83 pages. Price 30¢.* Circular 530, which presents a complete description of the National Bureau of Standards developmental work on an adhesive tape-resistor permitting close control of resistance values, may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

ENCYCLOPAEDIA OF OXY-ACETYLENE WELDING. *By L. J. Tibbenham. Published by the Pitman Publishing Corp., New York 36, N. Y., 1952. Cloth, 5¾ by 8¾ in., 73 pages. Price $2.50.* A practical work of reference, set out in dictionary form, to give complete and concise information on all matters connected with oxyacetylene welding. Valuable tables of data required for welding operations are included.

THERMAL FATIGUE AND THERMAL SHOCK. *By Helmut Thielsch. Published by Welding Research Council, New York 18, N. Y., 1952. Paper, 8¼ by 11¼ in., 24 pages. Price $1.00.* Bulletin No. 10 is a review of published and unpublished information on characteristics of thermal fatigue and shock; effects of stresses, design, structure, carbon migration, intergranular oxidation, phase transformations, welding, etc.; occurrence of thermal fatigue and shock in various applications; and testing procedures used to evaluate thermal fatigue and shock.

101 NEW USES FOR PORCELAIN ENAMEL. *Published by the Porcelain Enamel Institute, Washington 5, D. C., 1952. Price $6.00.* This widely-discussed PEI booklet, which previously had been restricted to PEI members, is now available to all interested manufacturers and individuals. Specific advantages of porcelain enamel for each of the 101 applications are discussed.

ENGINEERING MATERIALS. *By Joseph Marin. Published by Prentice-Hall, Inc., New York 11, N. Y., 1952. Cloth, 6 by 8¾ in., 491 pages. Price $8.70.* Concerned with the mechanical properties and applications of engineering materials, this book was written in an attempt to provide the student with sufficient knowledge of the behavior of stressed materials to permit the intelligent selection and use of materials.

SHEET METAL WORK. *By Robert E. Smith. Published by McKnight & McKnight Publishing Co., Bloomington, Ill., 1952. Paper, 7¾ by 10¼ in., 76 pages. Price $1.00.* Complete information on the various kinds of sheet metal and the adaptability of each to industrial needs, as well as how to fabricate these metals into their many everyday uses, is presented.

SAE SHOT PEENING MANUAL. *Published by the Society of Automotive Engineers, New York 18, N. Y., 1952. Price $1.50 to SAE members; $3.00 to non-members.* Twenty-four of the country's leading authorities on shot peening, working under the SAE Iron & Steel Technical Committee, spent two years in compiling this Manual, which covers the waterfront on shot peening for designer, process engineer and production man—from what shot peening is and does, to machines and materials used. It also details current practice in peening various type parts.

ing features, physical properties, chemical resistance of unicellular polyvinyl chloride plastic. (58)

Rubber Parts. Stalwart Rubber Co., 16 pp, ill, No. 51SR-1. Describes applications and fabrication of rubber compounds designed to resist temperature, abrasion, chemicals and weathering. (59)

Molded Ceramics. Star Porcelain Co. Technical data on characteristics of molded ceramic products for electrical wiring, electrical heating and special purposes. (60)

Molded Thermoplastics. Tri-State Plastic Molding Co., Inc. Folder describes this company's facilities for producing to order thermoplastics parts by injection molding. (61)

Carbon-Graphite Parts. U. S. Graphite Co., 68 pp, ill, No. G-49. Properties, chemical resistance, limitations, assembly information, design aids and 60 applications of Graphitar. (62)

Rubber Products. U. S. Rubber Co., 25 pp, ill, No. M-9012. Detailed description of new research and development laboratory, indicating its place in development of rubber products. (63)

Plastic Tubing. U. S. Stoneware Co., 23 pp, ill, No. T-77. Discusses engineering properties and uses of vinyl plastic material in extruded form. (64)

Felt. Western Felt Works, 32 pp, ill. History of manufacture and uses of felt, including brief description of present-day methods and applications. (65)

Industrial Plastic. Westinghouse Electric Corp., 36 pp, ill, No. B-3184-D. Data book on properties, grades, shapes and sizes, applications and machining of Micarta, a reinforced resin. (66)

Metal Parts • Forms

Die Castings. Accurate Die Casting Co., 21 pp, ill. Pictorial tour through this company, showing various departments and equipment. Illustrates large variety of die casting applications. (67)

Precision Castings. Alloy Precision Castings Co., 8 pp, ill. Describes frozen mercury process for close tolerance precision casting of parts to order. Shows numerous products. (68)

Aluminum Extrusions. Alsco, Inc., 6 pp, ill. Lists and illustrates this company's assembly and manufacturing plants and equipment for producing aluminum extrusions. (69)

Aluminum Extruded Shapes. Aluminum Co. of America, No. AD-229. Explains potentialities of extrusion process for aluminum as money-saver in fabrication operations. (70)

Aluminum Castings. Aluminum Industries Inc., 4 pp., ill, No. 20.A. Describes this company's facilities offered to industrial plants that need aluminum castings for defense jobs. (71)

Certified Die Castings. American Die Casting Institute, Inc. Discusses plan to protect zinc alloy die castings buyers by subjecting producers' products to regular testing. (72)

Continuous-Cast Copper Alloys. American Smelting and Refining Co., 12 pp. Technical data on company's continuous-cast copper alloy rods, tubes and shapes. (73)

Precision Investment Castings. Arwood Precision Casting Corp., 16 pp, ill. Informative article on precision investment castings. Includes table of alloys recommended as most adaptable for this process. (74)

Precision Castings. Atlantic Casting and Engineering Corp., 12 pp, ill. "High Quality Precision Castings for Industry" illustrates Atlantalloy casting process, gives specifications and describes all specified metals, their characteristics and uses. (75)

Welded Steel Tubing. Avon Tube Div., 11 pp, ill. Gives advantages, specifications of Fusionweld steel tubing, and illustrates uses and applications. (76)

Tubing Performance. Babcock & Wilcox Co., Tubular Products Div., 40 pp, ill, No. TR516. Results of a number of investigations of failures of tubing at high temperature and pressure service. (77)

Magnesium Parts. Brooks & Perkins, Inc. Characteristics of, and design data on magnesium alloys. Shows examples of made-to-order parts produced. (78)

Stainless Steel Forms. G. O. Carlson, Inc., 4 pp, ill. Tank heads, large steel plates, tubing, sheets, forgings and billets, all of stainless steel, are shown as typical of the forms available from this company. (79)

Thermostatic Bimetal. W. M. Chace Co., 4 pp, ill, No. 1a/10. Properties of thermostatic bimetals and formulae to use in application to temperature responsive devices. (80)

Rolled and Welded Parts. The Cleveland Welding Co., 8 pp, ill. Describes welded circular and rolled steel parts, their advantages in economic and physical aspects and their applications. (81)

Pre-Coated Metal Strip. Coated Coils Corp., 513 W. 30th St., New York City, 3 pp, ill. Versatile color finishes produced by an exclusive process is illustrated by actual sample of Enamelstrip, the metal coil precoated in color. Address inquiries to Mr. M. Richfield, Adv. Mgr.

Stainless Steel Castings. Cooper Alloy Foundry Co., 5 pp, ill. Describes in detail methods by which intricate stainless steel castings were turned from problem castings into large scale production jobs. (82)

Metal Stampings. Dayton Rogers Mfg. Co., 9 pp, ill. Illustrates typical examples of savings effected by producing die-cut stampings in small lots. (83)

Perforated Metals. Diamond Mfg. Co., 24 pp, ill, No. 35. Uses, advantages and specifications of various types of perforated metals. (84)

Custom Steel Parts. H. Disston & Sons, Inc., 16 pp, ill. Describes custom steel parts, how they are made and how to use and order them. (85)

Forged Parts. Drop Forging Assn., 60 pp. "Metal Quality" gives detailed data on the effects of hot working metals, describing properties obtained, advantages and limitations. (86)

Corrosion Resistant Castings. The Duraloy Co., 16 pp, ill, No. 3150-G. Describes facilities for manufacture of chromium-iron and chromium-nickel castings. Gives detailed properties of alloys and their uses. (87)

Magnesium and Aluminum Castings. Eclipse-Pioneer Division Foundries. "Book of Facts" shows company's facilities for custom-making aluminum and magnesium castings. (88)

Metal and Plastics Parts. The Electric Auto-Lite Co., Bay Manufacturing Div., 16 pp, ill. Shows wide variety of custom-made ornamental and functional metal and plastics parts. (89)

Die Cast Parts. The Electric Auto-Lite Co., Die Casting Div., 16 pp, ill, No. G137. Describes facilities for economical manufacture of quality die castings. (90)

Corrosion Resistant Castings. Electro-Alloys Div., American Brake Shoe Co., No. T-171. Properties and engineering uses of Chemalloy corrosion resistant alloys for casting. (91)

Steel Castings. Farrell-Cheek Steel Co., 4 pp, ill, No. 40. Examples of the intricate electric furnace carbon and alloy steel castings produced by this company. (92)

Mechanical Seals. Garlock Packing Co., 12 pp, ill. Construction, service and sizes of a variety of this company's mechanical seals for rotary shafts. (93)

Gray Cast Iron. Gray Iron Founders' Society, Inc. Gives mechanical and engineering characteristics of gray cast iron. Includes details for designing cast components. (94)

Investment Castings. Gray-Syracuse, Inc., 4 pp, ill. Various parts of precision-cast brass, bronze, beryllium copper and steel. (95)

Zinc Die Castings. Gries Reproducer Corp., 8 pp, ill. Detailed data on properties, design advantages and improved uses of tiny zinc alloy die castings. (96)

Precision Investment Castings. Hitchiner Mfg. Co., Inc., 6 pp, ill. Evaluates precision investment casting methods as to costs, production and properties of parts. (97)

Die Castings. The Hoover Co., Die Castings Div. Describes die casting; gives essential design data, including draft, tolerance and wall thickness and core size requirements. (98)

Iron and Steel Castings. Hunt-Spiller Mfg. Corp. Folder describes extensive facilities for production and finishing of iron and steel castings of any size and quantity. (99)

Helical Compression Springs. Instrument Specialties Co., Inc., 2 pp., ill. How to obtain economical assortment of 1100 beryllium-copper compression springs for development work. (100)

Investment Castings. Investment Casting Co., folder. Advantages and capabilities of this company's facilities for production investment castings to customers' specifications. (101)

Bronze Bars. Johnson Bronze Co., 4 pp, ill. Description and specifications of this company's finished bronze bars, both hollow and solid for use in bearing manufacture. (102)

Cemented Carbide Parts. Kennametal Inc., 72 pp, ill, No. 51. Characteristics of Kennametal compositions, design suggestions for their use, and descriptions of numerous standard parts. (103)

Metal Rings. King Fifth Wheel Co. Catalog and capacity charts of this company's facilities for bending and welding metal rings for industrial purposes. (104)

Alloy Steel Castings. Lebanon Steel Foundry, 4 pp. "At Your Service" contains useful data on products and personnel of Lebanon, with summarization of company's

MANUFACTURERS' LITERATURE

manufacturing facilities. (105)

Pressed Parts. Lenape Hydraulic Pressing and Forging Co. Catalog shows numerous parts press formed by this company illustrating the kinds of jobs this firm can perform. (106)

Die Castings. Litemetal DiCast, Inc., 12 pp, ill. How to select best light metal for die casting. Shows facilities producing light metal pressure die castings. (107)

Controlled Quality Castings. Meehanite Metal Corp., 8 pp, ill, No. 31. Engineering data on casting, plus specific applications showing capabilities of Meehanite gray iron castings. (108)

Tungsten Carbide Parts. Metal Carbides Corp., 68 pp, ill, No. 50-G. Descriptions, specifications and prices of standard Talide Metal dies, rolls, bushings, forms and special shapes. (109)

Ferrous and Nonferrous Metal Forms. Metal Goods Corp., 274 pp. Complete stock list and ordering information on metal parts and forms supplied by this company. (110)

Threaded Stampings. Mohawk Mfg. Co., 2 pp, No. 851. Illustrates variety of products produced by Mohawk's stamping processes, guaranteeing uniform threaded parts with uniformly threaded holes. (111)

Aluminum and Zinc Castings. Monarch Aluminum Mfg. Co., folder. File pages on this company's developments in aluminum and zinc casting. Each folder distributed kept up-to-date. (112)

Plastic Coated Metal Tubing. Samuel Moore & Co., 4 pp, ill, No. F-2008. Describes properties, fabrication, available forms and fittings of Dekoron, plastic coated metal tubing with numerous uses. (113)

Screw Machine Parts. Mueller Brass Co., 6 pp, ill. Shows brass, bronze and copper custom-made screw machine parts available, and lists other nonferrous products. (114)

Seamless Tubing. National Tube Co. Explains time- and cost-cutting fabricating applications of this company's Shelby seamless tubing. (115)

Nonferrous Die Castings. The New Jersey Zinc Co., 28 pp, ill. Applications and principal features of Zamak-3 and Zamak-5 zinc alloy die castings. (116)

Precious Metals. The J. M. Ney Co., 19 pp, ill, No. R-21. Properties, recommended uses and specifications of available types of precious metal alloys for sliding electrical contacts. (117)

Corrosion Resistant Castings. The Ohio Steel Foundry Co., 4 pp, ill, No. FC-350. Shows numerous stainless steel castings exemplary of the parts that can be cast by this company. Table of alloy specifications included. (118)

Copper Tubing. Penn Brass & Copper Co., 6 pp, ill. Features of this company's seamless copper tubing. Includes tables of safe internal working pressures of various tubing sizes. (119)

Mechanical Steel Tubing. Pittsburgh Tube Co., 44 pp, ill. Detailed information on characteristics, physical properties, fabrication and specifications of this firm's butt welded tubing. (120)

Metal Powders. Plastic Metals Div., 4 pp, ill, No. 567. Describes applications, advantages and limitations of powder metallurgy as used by this firm for custom-making parts. (121)

Powder Metal Parts. Powdered Metal Products Corp. of America. Booklet shows advantages of powder metallurgy in manufacture of such parts as gears, sprockets and valves. (122)

Stainless Steel Tubing. Republic Steel Corp., 28 pp, ill. Detailed data on Electrunite stainless tubing, its fabrication, corrosion resistance, applications and other helpful information. (123)

Rigidized Metal. Rigidized Metals Corp., 8 pp, ill, No. CF1. Shows advantages of using rigidized stainless sheet metals in place of other sheet. Shows several available patterns, indicates many uses. (124)

Wire Screens. John A. Roebling's Sons Co., Woven Wire Fabrics Div., 12 pp, ill, No. W-903. Specifications of company's standard screens for grading uniformly and long life. (125)

Spun Metal Parts. Spincraft, Inc., No. 3. Data book on metal spinning and fabricating gives data on process and help in designing for economical production. (126)

Contact Materials. Stackpole Carbon Co., No. 12. Shows company's contact types of such materials as silver graphite, silver molybdenum and copper graphite. Includes data on materials and their applications. (127)

Steel Castings. Steel Founders' Society of America, 4 pp, ill, No. 29. Advantages of steel castings. Suggests economical aspects of steel casting for parts manufacture. (128)

Alloyed Gray Iron Castings. Superior Foundry, Inc., 8 pp, ill. Gives advantages, specifications, and illustrates production methods of Superior's electric furnace process for producing alloyed gray iron castings. (129)

Small Tubing. Superior Tube Co., No. 31. Describes facilities for custom fabricating seamless or welded tubing of all analyses in sizes to 5/8-in. o.d. (130)

Brass and Bronze Products. Titan Metal Mfg. Co., 28 pp, ill. "Behind the Scenes" presents pictorial tour through various departments of Titan; shows equipment for the manufacture of brass and bronze products to meet individual specifications. (131)

Steel Forgings. Titusville Forge Div., Struther Wells Corp., 8 pp, ill. Describes facilities for precision forging of parts regardless of size, metal or alloy. Shows numerous parts produced. (132)

Formed Tubing. Tube Reducing Corp., 4 pp, ill. Stresses economic advantages of hot-forming complex tubular parts in the plant in which the precision tubing is made. Describes this company's facilities. (133)

Steel Castings. Unitcast Corp., Steel Casting Div., folder, No. 1248S. Describes modern facilities for producing and testing high grade molding sand for good steel casting. (134)

Centrifugal Cast Parts. U. S. Pipe and Foundry Co., 12 pp, ill. Describes centrifugal casting process and advantages and shows three applications improved by this method. (135)

Self-Lubricating Bearings. Wel-Met Co., 3 pp, No. 104. Lists 133 MPS standard self-lubricating bearing sizes and gives inside and outside diameters and length dimensions. (136)

Light Metal Shapes. R. D. Werner Co., 4 pp, ill. Explains relative merits of cold roll forming and extruding light metal shapes. Shows company's facilities for both types of fabrication. (137)

Coatings • Finishes

Hot Dip Galvanizing. American Hot Dip Galvanizers Assn., Inc., 8 pp, ill. Discusses hot dip galvanizing, the problems encountered by galvanizers, and its capabilities. (138)

Protective Coatings. Houghton Laboratories, Inc., 3 pp, ill. Applications and uses of "Coradon" and "Coradal" metal conditioning systems for abrasion and chemically resistant coatings. (139)

Wax Finishes. S. C. Johnson & Son, Inc., 16 pp, ill, No. ADV322. Brief description of wax finishes for such materials as rubber, metals, building materials, plastics, and paper and methods of application. (140)

White Enamel. Maas & Waldstein Co. Describes Codur, a gloss white baking enamel. (141)

Abrasion Resistant Coating. Minnesota Mining & Mfg. Co., Adhesives & Coatings Div., 4 pp, ill, No. Z-CSB. Details on EC-968, tough, abrasion resistant coating for polished metals. (142)

Black Oxide Coating. The Mitchell-Bradford Chemical Co., 4 pp, ill, No. MB-3. Six advantages of Black Magic (Type A) Black Oxide coating process for steel and iron. (143)

Wrinkle Finishes. New Wrinkle, Inc., ill. Folder shows typical products utilizing Wrinkle finishes. (144)

Phosphate Coating. Octagon Process Inc., 8 pp, ill. Describes Anchorite 100 phosphatizing compound for corrosion protection and paint bonding. Gives application methods and shows many uses. (145)

Strippable Protective Coating. Seal-Peel Inc., 3 pp, ill. Gives characteristics and advantages of this company's hot dip treatment strippable protective coating. (146)

Zirconium Glazes for Ceramics. The Titanium Alloy Mfg. Div., 30 pp. Description, uses and properties of TAM zirconium glaze opacifiers. (147)

Protective Coatings. United Chromium, Inc., 4 pp, ill, No. MC-4. Describes four different groups of Ucilon corrosion resistant coatings, giving properties, advantages and case histories. (148)

Methods and Equipment

Heat Treating • Heating

Continuous Quenching Tanks. America Gas Furnace Co., 4 pp, ill, No. 820. Specifications of complete line of continuous automatic quenching tanks. Shows several factory installations. (149)

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Controlled Quenching. Bell & Gossett Co., 4 pp, ill. Features of B&G Junior Quencher, completely self-contained unit combining quench tank with cooler, strainer and all control equipment. (150)

Furnace Heating Elements. Carborundum Co., Global Div. Complete data on Globar silicon carbide heating elements, said to be efficient, safe and easy to repair. (151)

Electric Sintering Furnaces. The Electric Furnace Co., 4 pp, ill. Descriptions and uses of nine EF sintering furnaces. (152)

Gas Heating Units. Gas Appliance Service, Inc., 4 pp, ill, No. 511. Shows various types of conveyor- and turntable-type heating units for volume brazing, soldering, annealing and hardening. (153)

Electric Tube Furnace. Harper Electric Furnace Corp., 1 p, ill, No. 1148. Describes small, high temperature electric tube furnace for heat treating operations up to 3000 F. (154)

Pit Type Convection Furnace. Hevi Duty Electric Co., 6 pp, ill, No. IND-451. Describes use, construction and specifications of Hevi Duty pit-type furnaces. Installation photographs show important industrial applications. (155)

Radiant Heating. Holcroft & Co., 8 pp, ill. Advantages, characteristics and limitations of radiant tube heating. Details on burner performance and design. (156)

Combustion Equipment. C. M. Kemp Mfg. Co., 27 pp, ill, No. B-11. Tells how combustion equipment offers fuel savings, is easier to install and maintain, cheaper to operate. (157)

Tool Furnace. Mahr Mfg. Co., 2 pp, ill, No. 11A. Features and operating principle of atmosphere and temperature controlled Type AC tool furnace. (158)

Refractory Cements. The Norton Co., 16 pp, ill, No. 863. Bulletin aids in selecting refractory cements for all types of applications. Includes tables of properties. (159)

Induction Heating. The Ohio Crankshaft Co. Describes plant survey and possible applications to which induction heating might be put for greater production economy. (160)

Electric Furnaces. Pereny Equipment Co., 3 pp, ill, No. 4A. Booklet tells advantages and illustrates typical group of this company's furnaces and kilns and their uses. (161)

Heat Treatment Equipment. Rolock, Inc., 36 pp, ill, No. B-7. Complete line of metal carriers for such operations as quenching, tempering, carburizing and metal cleaning. (162)

Heat Treating Furnaces. Westinghouse Electric Corp., 38 pp, ill, No. B-5459. "Harnessing Heat" describes 12 different types of gas electric furnaces and outlines their chief field of application. (163)

Electric Immersion Heaters. Edwin L. Wiegand Co., 48 pp. Catalog shows complete line of Chromalox electric heaters, giving applications and specifications. (164)

Portable Base Convector Furnaces. Lee Wilson Engineering Co., Inc., 19 pp, ill. Features and advantages of the new portable base single-stack furnace. (165)

Cleaning • Finishing

Blast Cleaning. American Wheelabrator and Equipment Corp., No. 844. Explains process of continuous blasting and illustrates how it is being applied in actual practice. (166)

Spray Painting. Conforming Matrix Corp., 5 pp, ill. Gives description, uses and advantages of this firm's spraying masks, mask washing machine, and spray painting equipment. (167)

Government Specified Products. E. F. Houghton & Co., 7 pp. Handy reference list of Houghton production meeting government specifications. Includes specification numbers, description and name of approved Houghton products. (168)

Barrel Finishing. Magnus Chemical Co., 11 pp, ill, No. 44. Describes in detail the four types of barrel finishing; tumbling, deburring, rolling and burnishing. (169)

Metal Cleaner. Niagara Alkali Co. Pamphlet gives properties of Nialk Trichlorethylene, high quality metal-cleaning and degreasing agent. (170)

Metal Cleaning. Northwest Chemical Co., 2 pp. Describes "LoHi" two-tank process for the preparation of metals for plating and vitreous enameling. (171)

Electroplating. Oakite Products, Inc., 28 pp, ill. Answers to many questions that affect success of electroplating on steel. (172)

Liquid Blast Cleaning Equipment. Pangborn Corp. Features, specifications and applications of this company's equipment for finishing of molds, dies, tools and other parts. (173)

Cleaners for Ferrous Metals. Pennsylvania Salt Mfg. Co., 8 pp, ill, No. S-560. Describes recommended Pennsalt alkaline cleaners for such methods as soak tank, spray and electrolytic cleaning. (174)

Metal Cleaner. Philadelphia Quartz Co., ill, No. 33-4. Describes Metso 66 soluble silica heavy duty alkali metal cleaner with brief recommendations for use. (175)

Industrial Brushes. Pittsburgh Plate Glass Co., Brush Div., Dept. W-4, 3221 Frederick Ave., Baltimore, Md. Case histories indicate economies available to users of Pittsburgh brushes. Request on company letterhead direct from this company.

Electrostatic Spray-Painting. Ransburg Electro-Coating Corp., 11 pp, ill. Describes new Ransburg No. 2 Electro-spray process, its uses and advantages. (176)

Tumbling Compounds and Processes. Tumb-L-Matic, Inc., 2 pp, No. PC-50. Describes new Tumb-L-Matic wet and dry processes for finishing parts by tumbling. (177)

Hard Chromium Plating Unit. Ward Leonard Electric Co., 4 pp, ill. Features of Model A-20 Chromaster industrial hard chromium plating unit; description of process and Chromasol solution. (178)

Welding • Joining

Brazing Alloys. The American Platinum Works, 46 pp, ill. Handy sized manual gives detailed description of the brazing process, alloys used, design of joints and other considerations for successful joining. (179)

Welding Aluminum Bronze. Ampco Metal, Inc., 12 pp. Illustrates and discusses test results of weldability characteristics of aluminum bronze sheet and plate. (180)

Self-Locking Nuts. E. A. Bessom Corp., 6 pp. Dimension charts of this company's various types of self-locking nuts. (181)

Welding Electrode. Champion Rivet Co., 18 pp, ill. Bulletin tells how to choose and use the correct electrodes and gives information on properties, diameters, polarity, current, etc. (182)

Bonding Resins. Ciba Co., 4 pp, ill. Properties of new group of resins, their applications as adhesives for metals and nonmetallics, moldings and coatings. (183)

Welding Positioners. Cullen-Friestadt Co., ill. Catalog shows line of hand or power operated welding positioners with capacities up to 30,000 lb. (184)

Soldering. Federated Metals Div., 16 pp, ill. Simple instructions and illustrations aimed at making soldering more successful and easier to do. (185)

Solder Paint. Fluxolder Products Co., 22 pp, ill. Advantages, operations and uses of Fluxolder solder paint. (186)

Welding Rod Coating Materials. Foote Mineral Co. Chemical specifications and general description of alloying materials, benders and slipping agents, arc stabilizers and fluxes. (187)

Stud Welding. Graham Mfg. Corp., 4 pp, ill. Shows features of this company's stud welding equipment. Also discusses operation and advantages. (188)

Brazing. Handy & Harman, ill, No. 54. *Brazing News* describes applications and developments of Easy-Flo and Sil-Fos low temperature silver brazing alloys. (189)

Noncorrosive Fasteners. H. M. Harper Co., 134 pp. Shows 7000 stock fasteners, including bolts, screws, nuts and rivets made of three to ten noncorrosive alloys. (190)

Special Fasteners. John Hassall, Inc. Complete line of cold-headed nails, rivets and screws from 1/32- to 3/8-in. dia. up to 7-in. lengths in a variety of finishes. (191)

Fastener. Huck Mfg. Co., 5 pp, ill. Description and specifications of Huck Lockbolts, new high shear strength fasteners incorporating principles of rivets and bolts. (192)

Induction Heating for Brazing. Lepel High Frequency Laboratories, Inc., 8 pp, ill. Details on induction heating units for accelerated brazing of parts. (193)

Argon Metal Arc Welding. The Linde Air Products Co., 6 pp, ill, No. F-7416 A. Procedures and equipment for argon metal arc welding, showing advantages and applications. (194)

Soldering and Brazing Equipment. Metallizing Co. of America, 8 pp, ill. Describes Mogul soldering gun and shows applications of its use to production-line soldering and brazing. (195)

Inert Arc Welding. Metal & Thermit Corp., 8 pp, ill. Advantages and operating hints on inert gas-shielded arc welding. Lists welding equipment specifications. (196)

Fastener. New Process Screw Co. Bulletin describes Twin-fast screws for rapid fastening of wood to metals, plastics or other woods. (197)

Self-Locking Fasteners. The Palnut Co., 1 p, ill. Describes self-locking machine screw Palnuts, coil tube fasteners, shield can fasteners and acorn Palnuts. (198)

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Self-Clinching Fasteners. Penn Engineering & Mfg. Corp., 16 pp, ill. Gives features and dimensional data on this firm's self-clinching and self-locating fasteners. (199)

Welding Positioners. Ransome Machinery Co., Industrial Div., 36 pp, ill, No. 210 C. Description, features and applications of 100- to 40,000-lb capacity welding positioners. (200)

Spot Welding Control. Reynolds Metals Co., 4 pp, ill, No. 15. *Reynolds Metals Technical Advisor* describes new "slope control," said to lengthen tip life and improve weld quality when spot welding aluminum. (201)

Fastener Demonstrator. Set Screw & Mfg. Co. Cardboard demonstrator shows the way Zip-Grip set screws lock themselves into place. (202)

Adjustable Fasteners. South Chester Corp., Southco Div., 4 pp, ill. Describes adjustable door fasteners for machinery doors. Said to be applicable quickly and resist loosening due to vibration. (203)

Self-Locking Nuts. Standard Pressed Steel Co., ill. Features and applications of Flexloc locknuts, listing prices and specifications of popular sizes. (204)

Stainless Steel Fasteners. Star Stainless Screw Co. Lists Star's stainless and special screw machine products available. (205)

Fasteners. Tinnerman Products, Inc., 24 pp, ill. Discusses qualities of Speed Nut fasteners, describing tests they must survive, their properties and costs, the ways they are produced. (206)

Weldments. The Van Dorn Iron Works Co., 10 pp, ill. Shows this company's facilities for producing weldments and other parts in all sizes and shows examples of the type of work produced. (207)

Forming • Casting • Molding • Machining

Die Casting Machine. A.B.C. Die Casting Machine Co., 4 pp, ill. Complete details and specifications of the 1-lb Zinc ABC die casting machine. (208)

Gas Cutting Machine. Air Reduction Sales Co., 60 E. 42nd St., New York City, 12 pp, No. 50. Describes features and advantages of the production-proven new Airco No. 50 Travograph. Address inquiries to Air Reduction on business letterhead.

Zinc Alloy Dies. Allied Products Corp., Richard Bros. Div., 4 pp, ill, No. W-35-950. Describes Allite zinc alloy dies for temporary production to test new forms while repairing permanent dies. (209)

Press Brake Dies. The Cyril Bath Co., 48 pp, ill, No. D-50. Catalog shows wide variety of press brake dies for curling, bending, offsetting, channel bending and other forming operations on metals. (210)

Specimen Cut-Off Machines. Buehler Ltd. Folder describes five cut-off machine models for samples from ½-in. to 3-in. dia. (211)

Machining Equipment. The Cincinnati Milling Machine Co., 48 pp, ill, No. M-1712. Features and specifications of this company's automatic flame hardening machines, grinding machines and milling machines. (212)

Chamfering Electrode. Eutectic Welding Alloys Corp., 25 pp, ill. Describes ChamferTrode, new rod for gouging, chamfering and milling operations on all metals and alloys without oxygen or special equipment. (213)

Semi-Automatic Presses. The Hydraulic Press Mfg. Co., 4 pp, ill, No. 5107. Gives description and specifications of H-P-M automatic compression molding presses for reinforced plastics molding. (214)

Metal Forming and Shaping. O'Neil-Irwin, 40 pp. "Die-less Duplicating" catalog shows parts duplicated by Di-Acro benders, brakes, shears, rod parters, rollers, notches and punches. (215)

Abrasive Belt Machining. Porter-Cable Machine Co., 27 pp, ill, No. 400. Gives specifications and uses of 12 models of abrasive belt machines for a wide variety of surfacing operations. (216)

Plastics Molding Press. F. J. Stokes Machine Co., 4 pp, ill, No. 503. Description and specifications for automatic plastics press. Typical products shown. (217)

Hole Punching Units. Wales-Strippit Corp., 3 pp, ill, No. HS. Illustrates and describes new Hydra-Strip hole punching units that punch and strip material up to ¾ in. thick. (218)

Aluminum Extrusion Presses. Watson-Stillman, ill, No. 340-A. Describes this company's light metals extrusion presses of 500- to 5000-ton capacity, their features and advantages. (219)

Adjustable Perforating Dies. S. B. Whistler & Sons, Inc. Catalog describes this company's line of adjustable perforating dies for punching holes in sheet metals. Includes prices and applications. (220)

Tube Mills. The Yoder Co., 65 pp, ill. Pros and cons of operating a tube mill, plus detailed information on the process. Also technical data on standard and other equipment. (221)

Inspection • Testing • Control

Laboratory Microscopes. Bausch & Lomb Optical Co., 24 pp, ill, No. D-185. Descriptions and specifications of various microscopes for such uses as metallurgical microanalysis. (222)

Films for Surface Analysis. The Brush Development Co., ill, No. 653. Applications of, and equipment for using Faxfilm for microscopically examining surfaces of various materials. (223)

Nondestructive Inspection. Dy-Chek Co., 4 pp, ill, No. 500. Describes simple method for nondestructive inspection of metal parts using penetrant dye sprayed on. (224)

Thermocouples. Charles Engelhard, Inc., No. 330-D. Shows features of full line of this company's noble metal thermocouples. (225)

Metallurgical Laboratory Equipment. Harshaw Chemical Co., Harshaw Scientific Div., 12 pp, ill, No. D2637. Catalog describes and gives specifications of this company's available metallurgical laboratory equipment. (226)

Nondestructive Testing. Magnaflux Corp., 13 pp, ill, No. 147. Describes application and operations of seven types of nondestructive testing. (227)

Industrial Instruments. Minneapolis-Honeywell Regulator Co., 28 pp, ill, No. 5000. Specifications of approximately 100 measuring and control instruments and valves. (228)

Compression Tester. National Forge and Ordnance Co., 2 pp, ill, No. 492. Description, features and uses of sensitive, sturdy, low-capacity-compression-crust testing machine. (229)

Temperature Controls. The Pyrometer Instrument Co., No. 150. Catalog shows Pyro Immersion Pyrometer, accurate instrument for nonferrous foundry temperature control. (230)

Tensile Testing Machines. Scott Testers, Inc., 6 pp, ill, No. 50. Shows wide assortment of testing machines for testing tensile strength of materials such as rubber, paper, wire and thread. (231)

Pyrometers. Tagliabue Instruments Div., 34 pp, ill, No. 1101 J. Detailed data on Celectray thermal indicating or recording controllers and accessories designed for high sensitivity and accuracy. (232)

Pyrometer Wire Color Codes. Thermo Electric Co., Inc. Handy chart gives pyrometer color codes, calibration symbols and parts meeting ISA, military and aeronautical specifications. (233)

Package Testing. United States Testing Co., Inc., 8 pp, ill. Describes methods for testing packages designed for products up to 1000 lb for vibration and impact. Includes prices. (234)

Hardness Testers. Wilson Mechanical Instruments Co., 12 pp, ill, No. DH-114. Descriptions and specifications of several Tukon hardness testers. Includes discussion of hardness testing and applications. (235)

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General

High Vacuum Pumps. Distillation Products Industries. Data on high vacuum pumps of unique design for such uses as metal processing and dehydration. (236)

Chain and Belt Conveyors. Michigan Steel Casting Co., 8 pp, ill, No. 1-B. Shows Misco rivetless chain conveyors and Woodman belt conveyors for high temperatures. (237)

Vacuum Unit. Radio Corp of America, Scientific Instruments Section, 4 pp, ill, No. EM.61. Features, applications, description and specifications of vacuum unit for vacuum deposition of metals and laboratory work. (238)

Sub-Zero Processing Cabinets. Revco, Inc., 2 pp, ill, No. STS-52. Gives features of Sub-Zero cabinet designed to maintain constant temperature and minimize heat loss during usage. (239)

Foundry Blowers. The Spencer Turbine Co., No. 112. Bulletin describes use of Spencer Turbos as blowers for foundries, giving blower features and advantages. (240)

Industrial Freezer. Webber Appliance Co., Inc., 3 pp. Features and specifications of low temperature mechanical refrigerating units. (241)

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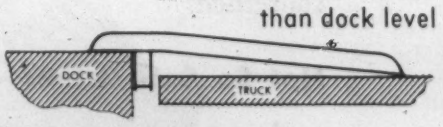

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- ☐ Steel Truck Loading Ramps
- ☐ Steel Car Loading Ramps

Firm_____

Individual_____

Street_____

City_____ State_____

The Editor's Page

The Conservative British

A recent issue of the British publication *Metal Industry* carried an item concerning a suggested new title in British industry. The suggestion is apparently the result of thought about increasing use of the Materials Engineering title in U. S. industry. Their name for the man is Metals Economy Engineer. The editors of *Metal Industry* could not be said to be enthusiastic about the new name. Neither are we.

The British editors realize what we have been preaching right along, and that is that metals and nonmetallics are so interrelated today that anyone charged with the responsibility of selecting materials must have a working knowledge of both groups. Even in this country, close observers will note that a die-hard magazine in the metal production and fabrication field is subtly backing into a coverage of plastics. The movement started with a few terse mentions in the advertising sections of the magazine. Then the editors got bolder, until finally, references to plastics are now found in the main news section.

Cooperation

I recently had the pleasure of appearing on the program of the Niagara Frontier Production Conference. The conference represented the cooperative efforts of some 30 technical groups in the area in and around Buffalo, N. Y. The leaders of the group are to be congratulated on the success of their first venture. More than 1000 engineers of the area attended the conference, and most felt that their time had been well spent. More cooperation of this type between engineering groups cannot but help be effective and worthwhile to all concerned.

Not So Soft Drinks

As anyone with an ulcer can tell you, the so-called soft drinks are hard on the stomach. Recently there have been some developments that indicate why this might be true. Sometime ago we heard that one of the cola drinks was being used by some garages as a means of derusting automotive parts dismantled during repair operations.

Now, according to the *Alcoa Aluminum News Letter,* the cola drinks are serving another useful function, besides quenching thirsts. Naturally, aluminum enters the picture, so the tale concerns the machining of Vanasil (a high silicon aluminum alloy). The metal is rather tough and has the reputation of ruining the edges on a tap or drill after one or two holes. One fabricator tried many lubricants, from the sublime to the ridiculous without any improvement. Somehow or other, the details are not clear, the cola and the metal made contact. The next hole drilled like a whiz. Then the new coolant-lubricant was tried deliberately and the success was repeated. So, if you have a drilling or machining problem, don't be dismayed, try a Coke or Pepsi.

Inviting Invitations

The denizen of this den is now making tentative plans for a forthcoming trip to the West Coast to make contact with news sources and to see for himself what is going on out there. So, he will welcome any suggestions on the part of readers as to where to go—to find good article material, we mean.

An Atomic Theory

A new theory has it that a method of changing the energy of atoms in metals could revolutionize our present-day machining methods. The theorist is looking for some yet-to-be-found cutting fluid capable of yielding atomic elements which he feels will do many wonders. "Dynatomics" is the name for this theory. Of course, if the answer to this problem is found, so many other answers will have been found that machinability might be the least of our worries. More power to the theory and to metal cutting.

Tyranny in Action

The actions of President Truman in seizing the steel mills aren't the only grabs for power that have come into evidence in recent weeks. If you will look at the room reservation forms of the American Society for Metals, you will see that the powers-that-be are trying to control your every movement at the next get-together. Apparently the show officials have bull-dozed each hotel manager in Philadelphia into giving up all of his rights for that particular week. The list of rules on the use of public rooms in hotels sounds very much like an effective restraint of trade and competition. We can only hope that high-handed treatment of this sort leads to open rebellion.

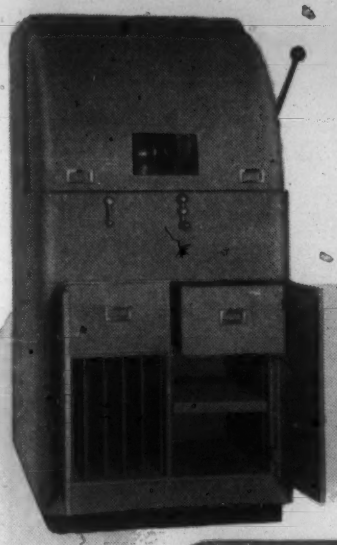
Those who participate in the Show, either as exhibitors or merely as attendees, should be entitled to the normal privileges of a city and its hotels—and should not be pushed around by a group who apparently can't stand the thought of competition.

T. C. Du Mond
Editor

Buehler

ABRASIVE CUT-OFF MACHINE

for the Metallurgical Laboratory

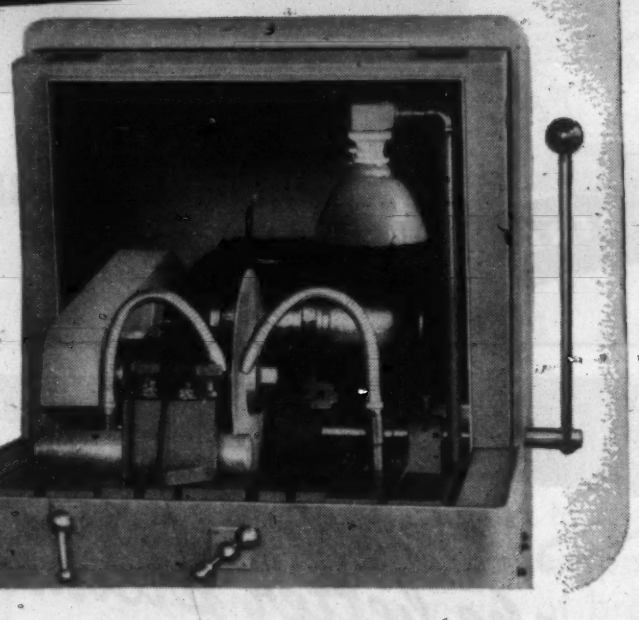


Completely enclosed—full protection for the operator

Fast cutting

Smooth operating

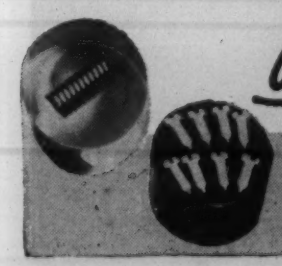
Model 1000



The Buehler Cut-off Machine No. 1000 is a solidly built heavy duty machine free from vibration and side play with capacity for cutting specimen sections up to 3½".

Cutting is done on the front of the wheel and is controlled by a convenient outside lever. With the cover closed, the cutting operation can be viewed through a heavy wired glass window. Regular equipment includes 3 HP totally enclosed ball bearing motor 1750 r.p.m., 220 v., 60 cycle, AC, 3 phase; pump motor ¼ HP, 220 v., 60 cycle, 1 phase; six cut-off wheels 12" x 3/32" x 1¼". Wheels not in use are stored in a spacious compartment in the base, which also contains a removable sludge collection chamber. The self-contained cooling system provides a flood of water for cool cutting. Overall dimensions 31" x 47" x 64". Shipping weight, 1400 pounds.

The BUEHLER line of specimen preparation equipment includes
—CUT-OFF MACHINES • SPECIMEN MOUNT PRESSES • POWER GRINDERS • EMERY PAPER GRINDERS • HAND GRINDERS • BELT SURFACERS • POLISHERS • POLISHING CLOTHS AND POLISHING ABRASIVES



Buehler Ltd.

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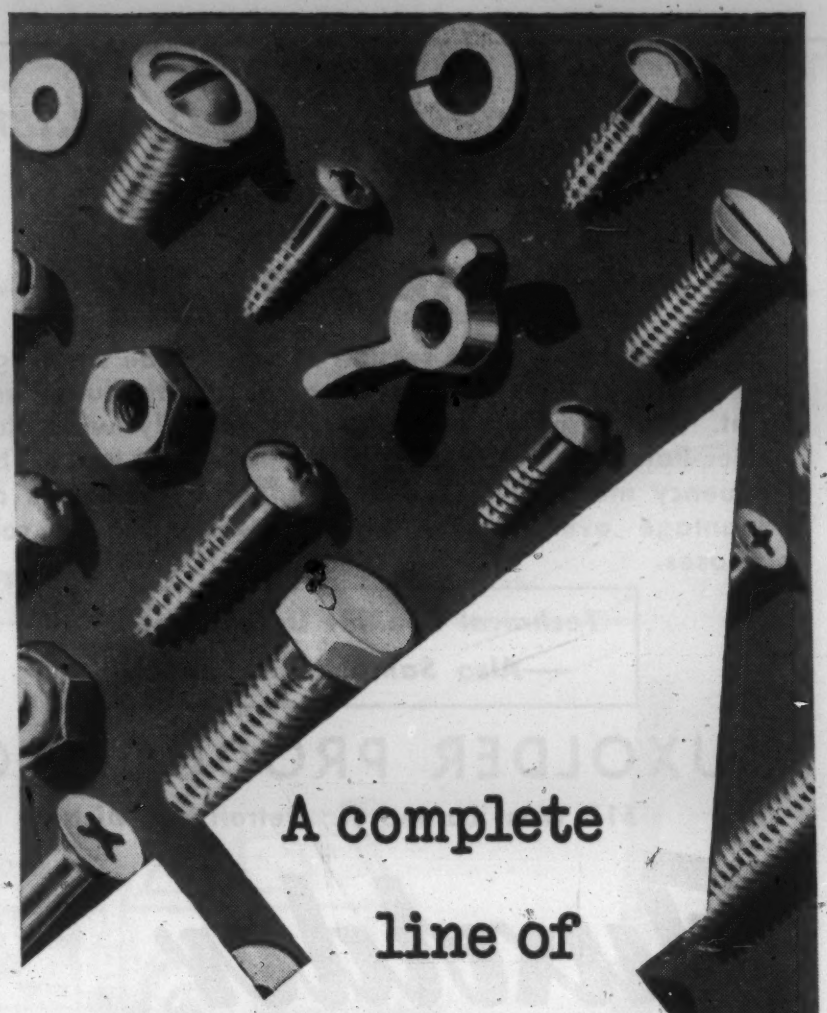

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Eliminate red rust and corrosion from dissimilar metals in your aluminum assemblies. Alcoa Aluminum Fasteners actually cost *less* than any other quality, corrosion-resistant fasteners. Choose from a complete line of nuts, screws, bolts, washers, rivets and cotter pins.

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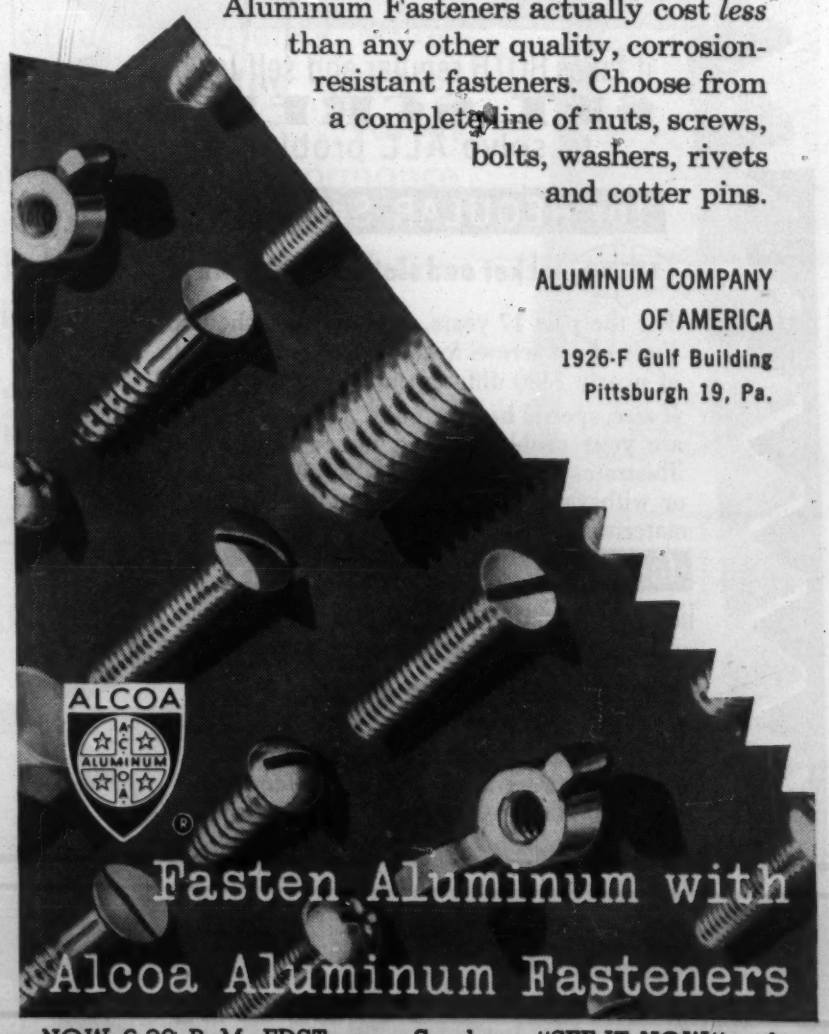

Fasten Aluminum with Alcoa Aluminum Fasteners

NOW 6:30 P. M. EDST every Sunday—"SEE IT NOW" with Edward R. Murrow . . . brings the world to your armchair . . . CBS Television

For Tinning and Sweat Soldering

FLUXOLDER SOLDER PAINT

The illustration shows a section of a fork tube with high-duty porous bronze bushings, sweat soldered with Fluxolder Solder Paint. The bushings are coated externally with Fluxolder Solder Paint, inserted into the fork tube and heated by high frequency method. "Fluxolder" Solder Paint shows a great advantage over all other methods for sweat soldering purposes.

Technical Booklet Upon Request —Also Sample for Testing

FLUXOLDER PRODUCTS CO.
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Fluxolder

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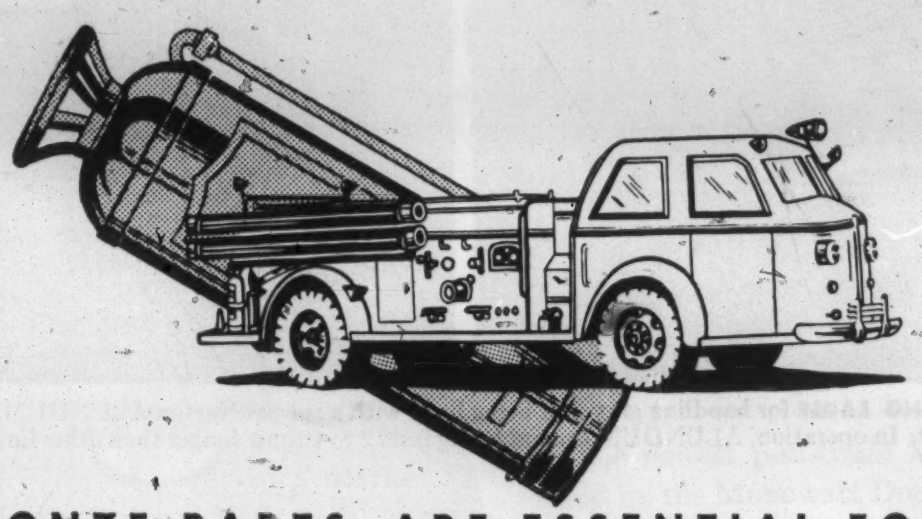

BRONZE PARTS ARE ESSENTIAL FOR FIRE FIGHTING EQUIPMENT . . . .

Fire fighting apparatus and other emergency equipment must be ready to perform when the occasion demands. Well designed parts . . . pumps . . . valves and fittings are made of bronze to avoid performance failures. Pressure tightness, resistance to corrosion, strength, ductility and anti-frictional characteristics are some of the qualities required.

Wherever liquids are used . . . in the Home or Industry . . . bronze parts play a vital role.

FREE . . . Write for your copy of the 8-page Lavingot Technical Journal — Vol. 8, No. 1 — containing an article discussing "Effects of Various Elements in Manganese Bronze."

Specify—LAVIN NONFERROUS INGOT—*Quality*

Brass · Aluminum · Bronze · Zinc Base Die Casting Alloys

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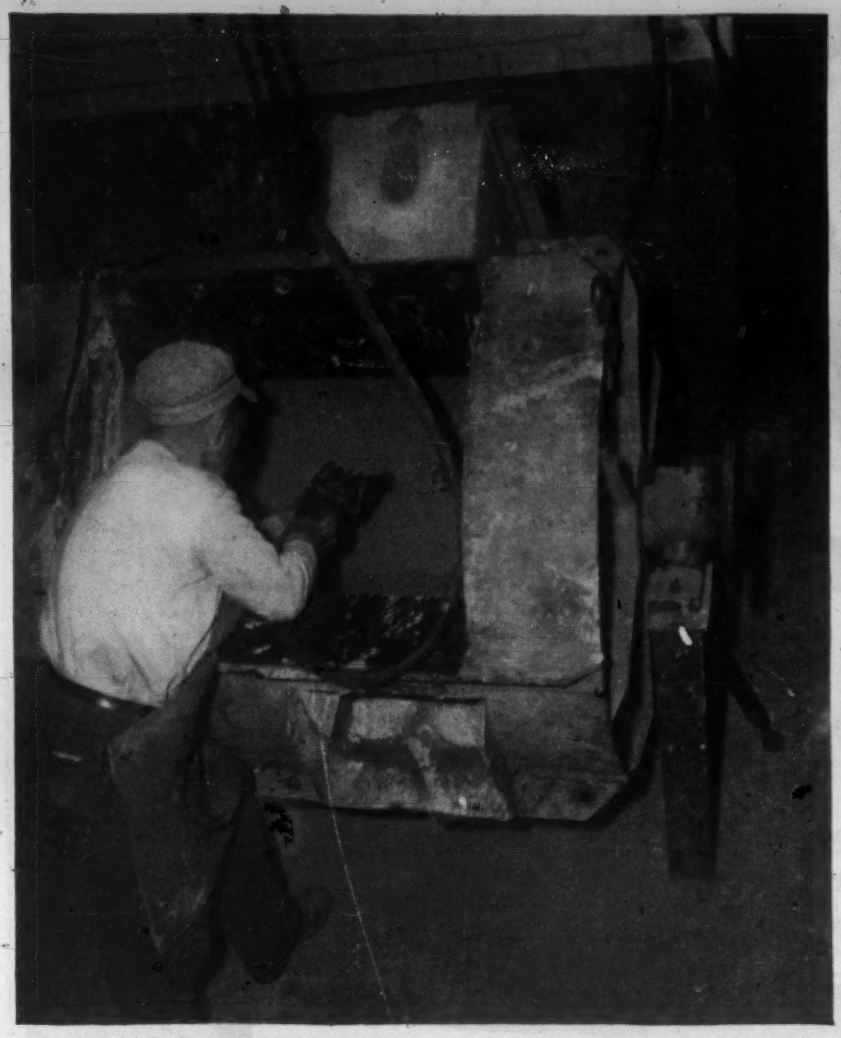
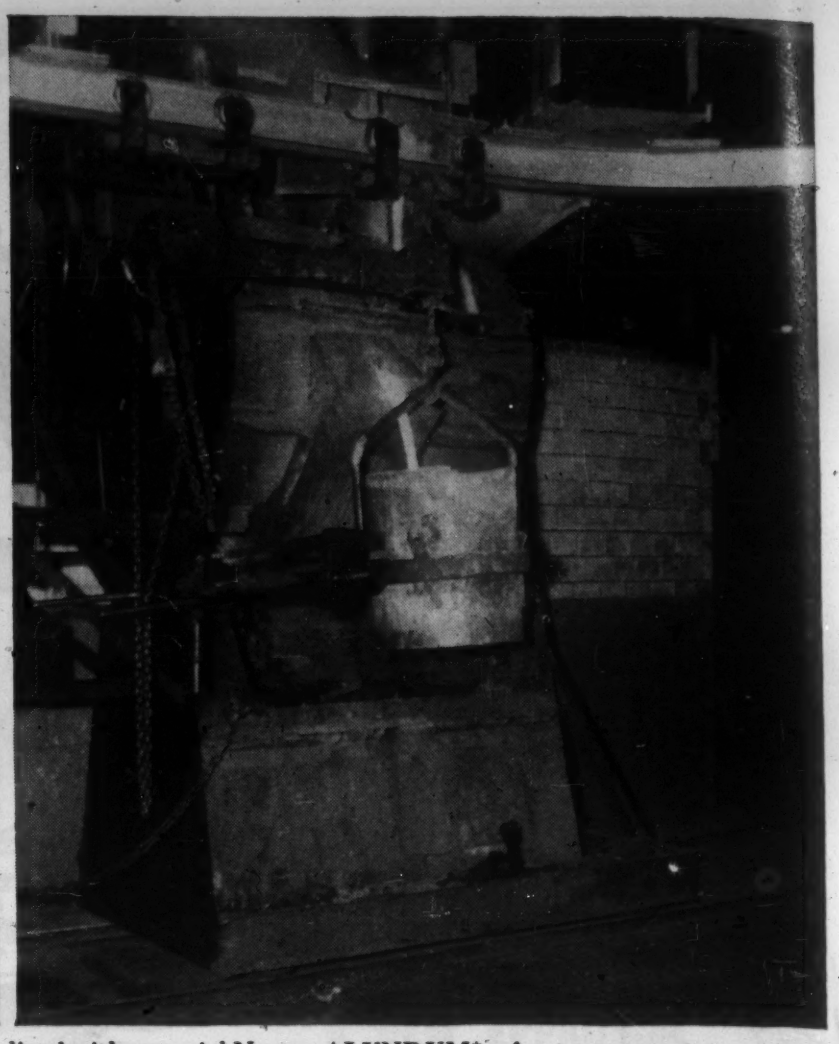




Left: **DESULPHURIZING LADLE** for handling gray iron being lined with a special Norton ALUNDUM* refractory cement.
Right: In operation, ALUNDUM cement lining lasts 2 to 4 times longer than other linings.

Desulphurizing ladle linings last up to 4 times longer

... *with Norton ALUNDUM cement*

How long do your present ladle linings stand the violent boiling action that results when you add sodium carbonate briquettes to desulphurize your gray iron?

Not long enough? Change to a special Norton ALUNDUM refractory cement and see what happens.

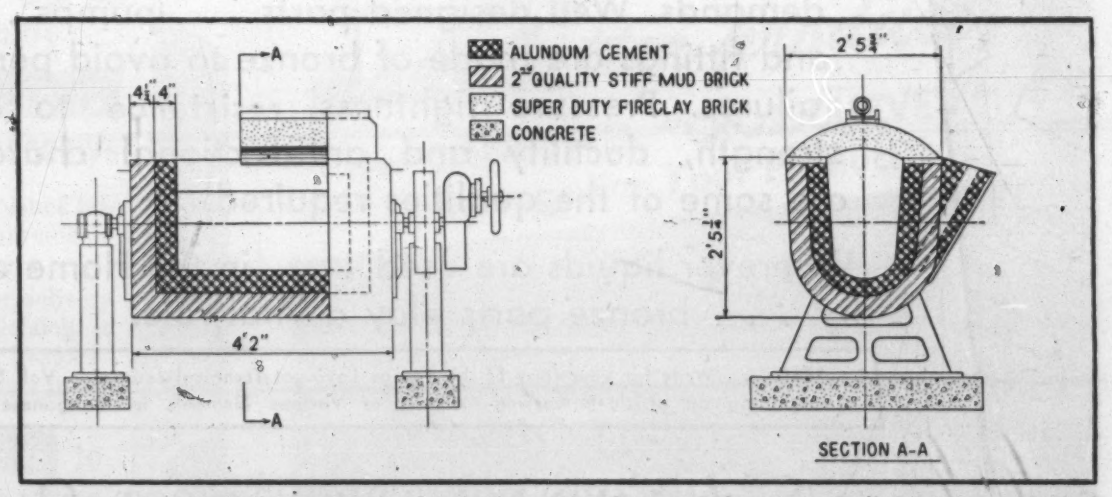
Test Shows Amazing Results

In one case, a foundry which operates a 1500 lb. capacity Whiting "U" shaped ladle for desulphurizing gray iron decided to test ALUNDUM cement. Lining life was increased 200-400%.

This foundry has now standardized on Norton ALUNDUM cement . . . and gets extra dividends in the form of easier installation, lower maintenance cost, lower over-all refractory cost.

Run a Test Yourself

Yes, why don't you test Norton ALUNDUM cement in your ladles, too? In the meanwhile, get further information from your nearby Norton representative — or write direct to NORTON COMPANY, Refractories Division, 343 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.



NORTON ALUNDUM CEMENT, in the test mentioned, was air-hammered 4" thick over 4½" of second quality stiff mud brick in the ladle and the entire spout. This was air dried overnight . . . and heated gently with a low-flame gas torch until thoroughly dried. Finally, the ladle was brought up to full heat and put into service.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

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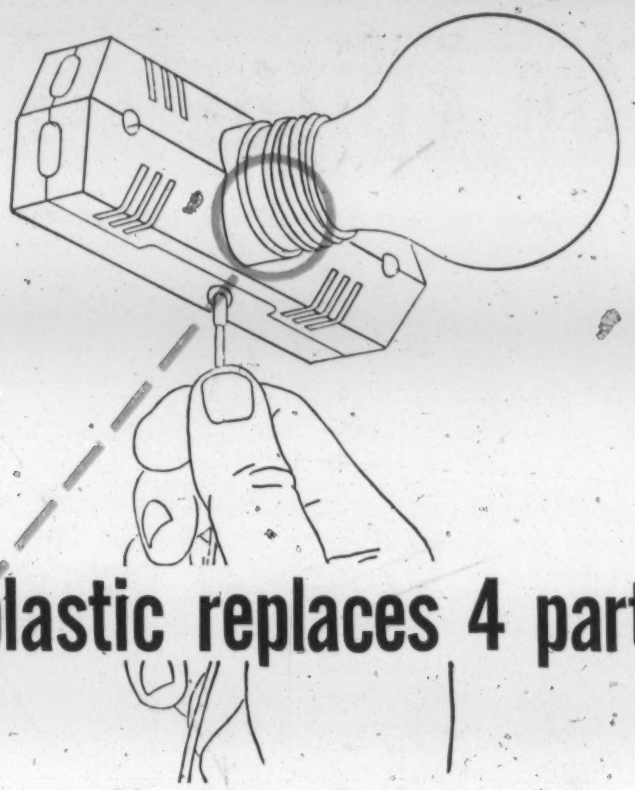
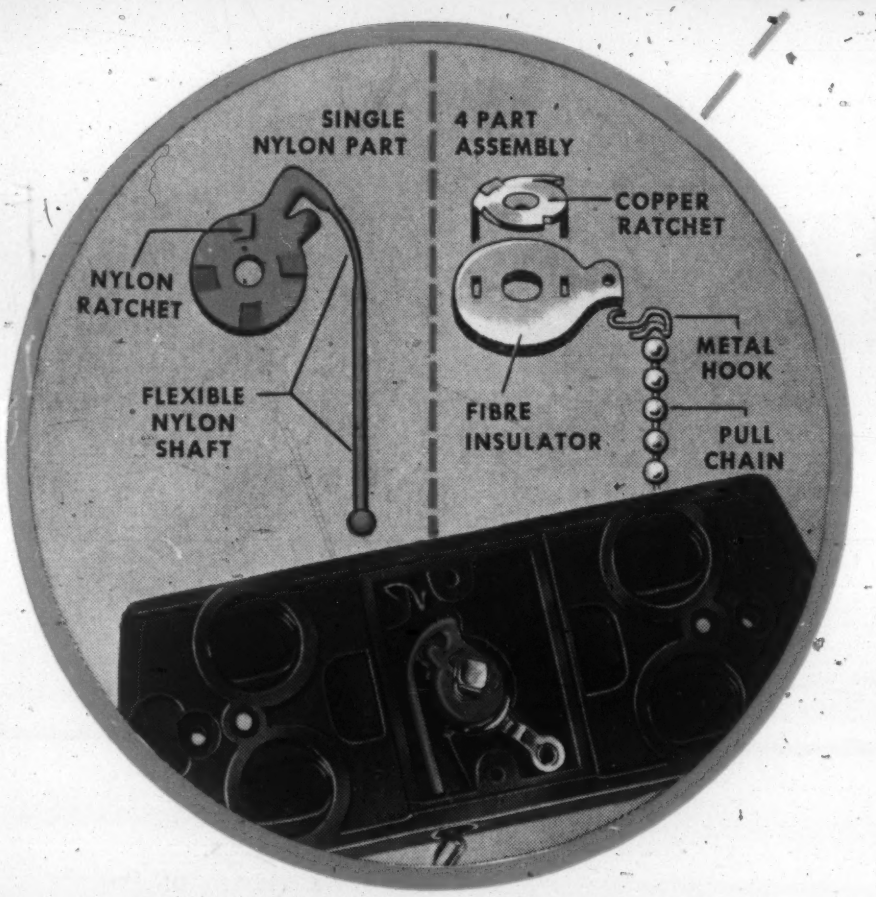
Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS



Part molded of Du Pont nylon plastic replaces 4 parts



Nylon part molded by the Gries Reproducer Corporation, New York, N. Y., for Monowatt Department, General Electric Company, Providence, Rhode Island.

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. . . through Chemistry
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in pull-chain light socket . . . cuts manufacturing costs . . . eliminates possibility of shock

In the newest pull-chain light sockets manufactured by the Monowatt Dept. of the General Electric Co., four parts—a copper ratchet, a fibre insulator for the ratchet, a short length of chain, and a hook to attach the chain to the insulator—are now replaced by just one part molded of Du Pont nylon plastic. The nylon part reduces manufacturing costs, simplifies assembly . . . and it eliminates *any possibility* of shorting or shocking regardless of dampness or other conditions. UL approved, the part showed no signs of wear after a 12,000-pull test.

This is an excellent example of improved design and better performance made possible by nylon's unique combination of properties. Where nylon replaces the copper ratchet, it has the necessary toughness to resist chipping and cracking. Where nylon replaces the fibre insulator, it has the dielectric properties to take a 250 watt-250 volt load without shorting or shocking . . . yet maintains its strength under high operating temperatures. And where nylon replaces the hook and chain, it has the strength and flexibility in thin sections to take pulling and bending, summer and winter.

Perhaps you can use Du Pont nylon plastic to improve or develop a product. Nylon is available. We'll gladly suggest suppliers of molded parts . . . gladly work with you in developing nylon parts to fit your needs. For further information, write:

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Polychemicals Department, District Offices:
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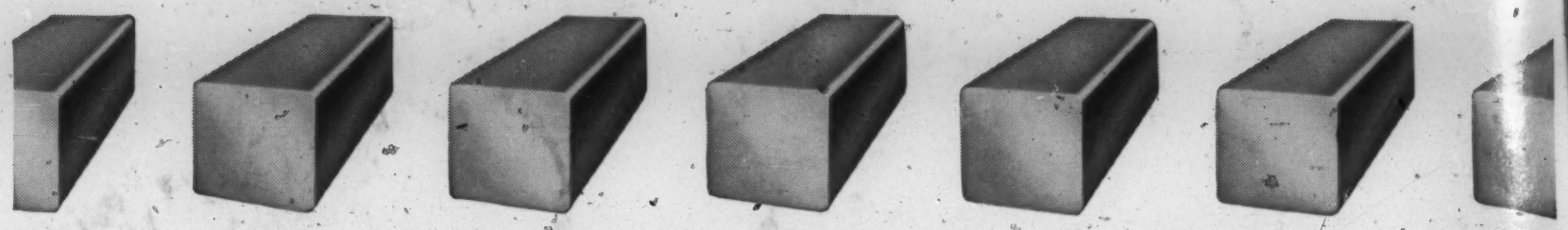
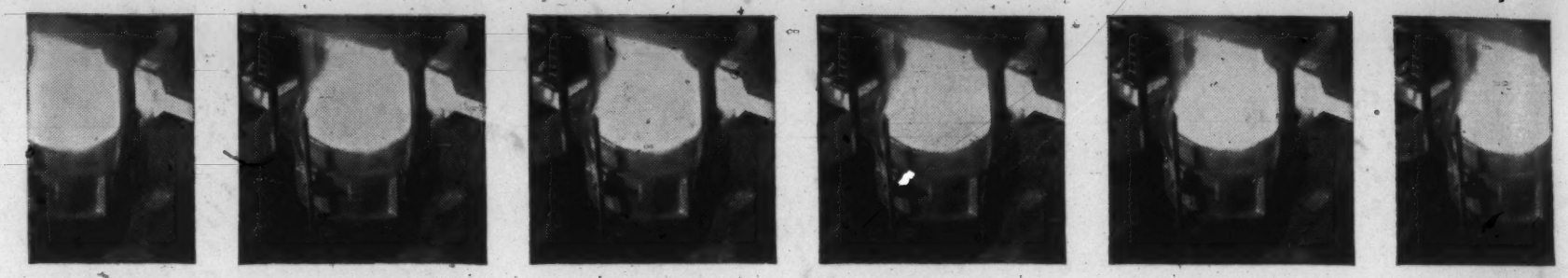
Because TIMKEN® forging steels are uniform from bar to bar...



and from heat to heat...



you get uniform forgings!

YOU can be sure of uniformity from bar to bar and heat to heat when you use Timken® forging steels. That's because the quality of Timken forging steels is rigidly controlled from melt shop through final inspection by the most precise methods known.

Because every analysis of Timken forging steel has uniform forgeability, with superior surface and internal quality, you get better and more uniform finished products. Rejects, delays and changes in shop practice are reduced.

For help in cutting your forging production costs, consult our Technical Staff. Write us today for our "Technical Bulletin, No. 31". The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

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